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QUARTERLY

OF THE

National Fire Protection Association

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National Fire Protection Association.

Executive Office, 87 Milk Street, Boston, Mass.

Active Members.

October 1, 1915.

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Western Canada Fire Underwriters' Association.
Western Factory Insurance Association.
Western Sprinklered Risk Association.
West Virginia Inspection Bureau.
West Virginia State Fire Prevention Association.
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Reports on fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

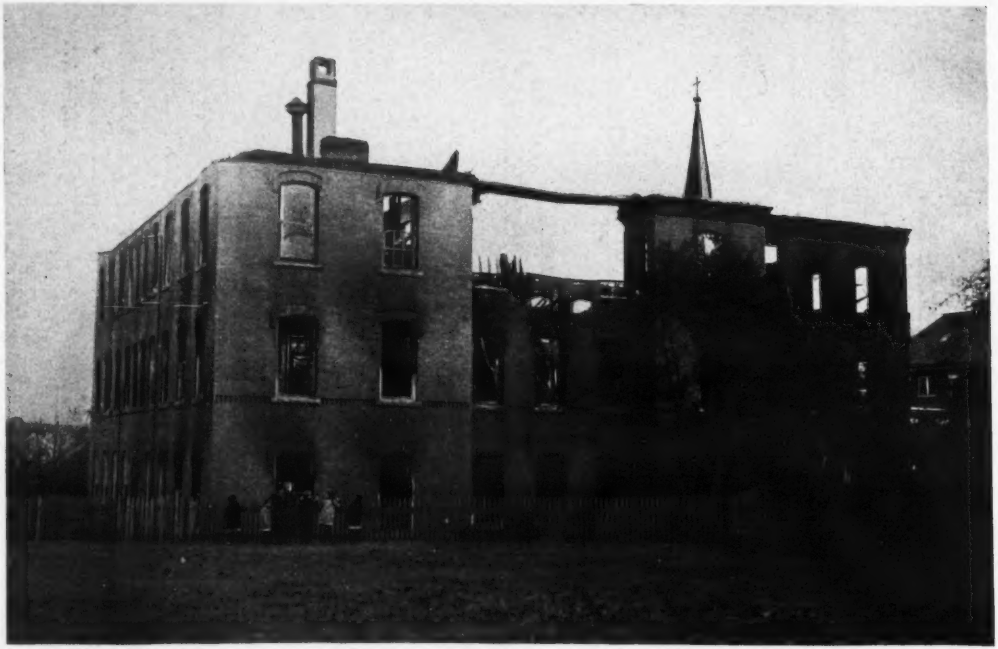

Photo by R. O. Dawson.

Peabody, Mass. St. John's Roman Catholic School Fire in Which Twenty-One Little Girls Were Burned to Death.

(See Editorial).

BURNING UP MONEY.

Yes, that expresses it exactly. Most "losses" benefit *someone*. The money merely changes hands. Fire losses benefit *no one*. It is human labor and natural resources *turned to ashes*.

—*Commerce Club, St. Joseph, Mo.*

The Quarterly

Vol. 9 October, 1915 No. 2

The "Individual Liability" Campaign. The success of the effort of the N. F. P. A. Committee on Public Information to crystallize the sentiment of the country in favor of assessing the expense of extinguishing fires upon individuals who ignore fire ordinances or fire department orders, is, so far, phenominal and indicates the rapidity with which the propaganda has spread, at least among those who are familiar with the conditions responsible for our huge fire waste. It seems to upset all those conservative predictions that years of effort must precede any legislation of this sort in America. Two of the leading national commercial organizations in our membership, the National Association of Credit Men and the National Paint, Oil and Varnish Association, passed unanimous resolutions in favor of this principle at their conventions of this year. Chairman Wentworth presented such a resolution at the Cincinnati convention of the International Association of Fire Engineers on September 2nd and at the Chicago convention of the Fire Marshals' Association of North America on September 10th. Both of these bodies passed the resolution unanimously. After the most favorable report of its committee on Publicity and Conservation (printed in this issue of the QUARTERLY this report and its accompanying resolution were adopted by the National Convention of Insurance Commissioners at Del Monte, California on September 23rd with but a single negative vote—that of the commissioner from New York state. Chairman Wentworth presented the resolution at the annual convention of the Pacific Coast Association of Fire Chiefs in San Francisco, September 27th which body passed it unanimously and spent a full session in discussing ways and means to secure the passage of laws and ordinances to that effect, and to enforce such legislation once secured. This quick response by these influential bodies in our active membership suggests to whom our committee may look for help before the state legislatures in asking for this desirable legislation.

Cleveland Shows the Way. The "personal liability" ordinance of the City of Cleveland, Ohio, was printed on page 46 of the July QUARTERLY. This ordinance, which became effective on July 12th, provides, it will be noted, for a fine of $50 and a penalty of $3 per day while defects remain uncorrected after the date indicated by the fire warden, and the payment to the city of the total cost of extinguishing any fire resulting from such uncorrected defects. Alfred A. Benesch, Director of Public Safety does not intend that this ordinance shall remain a dead letter. A new inspection blank has been prepared for the bureau of fire prevention, upon the back of which the new ordinance is printed in full. When a defect is found the occupant of the premises is served with this notification signed by Chief Warden Thos. F. Connell, in charge of fire prevention, and countersigned by the fire warden of the district. The record is then official and the citizen knows what the result of ignoring the order may be.

The secretary of the N. F. P. A. has a number of these inspection blanks and will send a copy to any member on request. They will serve a good purpose in other cities contemplating a revision of their fire ordinances in the line of progress.

* * * * *

Albert Blauvelt's Plan. It has for some time been recognized that the method of comparing the fire loss of nations by a per capita division of the total is not very illuminating, although it has a superficial value. A single fire in any one year may double the average local fire waste while really a very substantial progress may have been made in fire prevention. The number of fire alarms per capita is the best barometer, and a steady reduction in these, which many cities already show owing to the establishment of organized fire department inspections and consequent better housekeeping, is the best indication of improvement in habits and hazards. While any one fire may burn a whole city, every fire however small or quickly extinguished is significant. Albert Blauvelt, whose article "Bad Law and the U. S. Fire Waste" published in the QUARTERLY for April, 1914 attracted so much attention, has worked over that article from the new standpoint of fire alarm comparison. The term he uses is "fire frequency" per capita. The revised article recently appeared in the *Journal of Political Economy* and is well worth a place in that publication. Mr. Blauvelt writes for thoughtful people, and his productions are always painstaking. In abandoning the ordinary fire loss per capita method of comparison, and declaring that such statistics related to the public wealth lack meaning, he works out a new table from the "fire frequency" point of view, which is even more startling in its significance.

The table does not give the figures for the past three years, during which the city fire prevention bureaus have really gotten under way, but is illuminating nevertheless, and indicative of the need for all the exertion the N. F. P. A. and its allies are making for fire prevention.

Mr. Blauvelt's figures of the increase in frequency of fires in the large cities of the country are here given.

Three-year average number of fires per 10,000 population in six leading cities of the United States by decades.

	1879-81	1889-91	1899-01	09-11
New York	12.3	21.8	25.8	35.1
Chicago	15.0	27.0	34.7	38.4
Philadelphia	9.3	11.3	22.0	24.0
St. Louis	10.5	20.5	29.2	46.0
Boston	13.1	16.0	29.6	42.4
Baltimore	9.9	13.9	23.0	26.6

Mr. Blauvelt is a thorough believer in the necessity for personal responsibility for fires. He argues that owners of property ought to pay initial losses up to 10 per cent. His arguments are summed up as follows:

1. By insuring at 90 per cent. and assuming the first 10 per cent. of the risk, the insured could collect more in case of total loss than he can under his present practice of attempting to economize by saving 10 per cent. or more at the top of his valuation.

2. He could more than afford to insure to the full 90 per cent. because he would benefit from the reduction in the cost of insurance that would immediately be due (especially in cities) on his assuming for himself all small losses and not imposing on the public the utterly disproportionate expense and overclaims attending minor claims. Few people realize how large such saving would be or how easily the same can be determined.

3. He could look for a second large saving in the reduction of the fire cost chargeable to careless neighbors. The careless ones might not become immediately heedful, they might continue to expect fires and to put their main reliance on the fire department's services, but the wholesome initial burden which the careless owners would be obliged to bear would be a direct reduction of public insurance costs. There is possibility for immense improvement here, as all authorities agree that most fires are due to careless indifference.

4. The legitimate insured could expect from public-interest insurance an additional saving through decrease in incendiarism.

5. The fact that no "blanketing" nor dividing of insurance policies could evade public-interest insurance would develop a fifth source of saving. The only possible method of reducing the owner's liability would be to divide the burnable values. This would be an incentive toward the more general use of separated and subdivided buildings, which by limiting spread of fire also lessen the need for huge fire departments.

6. As every city fire is a potential conflagration, the broad interests of city and country would be safeguarded in proportion as the frequency of city fires became lessened.

Mr. Blauvelt's idea may soon receive a tentative and voluntary application in the state of Wisconsin. It is authoritatively stated that many insurance managers would favor a liberal reduction in rates for properties on which the owners will agree to bear the first 10 per cent of loss in case of fire. While this idea is called revolutionary, and perhaps is so when conventional insurance jurisprudence is considered, it is obviously "long" on common sense. Should this principle crystallize into law, it would wipe out the occupation of the petty adjuster, which would be a very great gain to the insurance companies and the public. If the people are ready for fixing individual liability for easily preventable fires, they may soon discover that Mr. Blauvelt is not a revolutionary at all but a most conservative conservator.

Aviator Helps Locate Forest Fires. An aviator, L. A. Vilas, has been appointed to watch for fires in the region around Big Trout Lake in Wisconsin. He can, using his hydro-aeroplane, rise in a few minutes to an altitude of one thousand feet and survey two hundred thousand acres of forested land. If he detects smoke he can in a few minutes report to the district forestry headquarters. The use of a flying machine would seem to be particularly valuable for this kind of work where the country is flat or where there are no high elevations upon which lookout stations may be placed. In flat or rolling lands lookout towers enable the observer to guard a territory of rather small area, whereas an aviator at the height of 1,000 feet can detect a fire thirty or forty miles away. Mr. Vilas recently discovered a fire thirty miles off and on investigation it was found that he had made an accurate estimate of the distance. He is quoted as saying:

> The machine I am using is a standard Curtis four-passenger flying boat. This machine has an average speed of about sixty-two miles an hour in the air and forty miles an hour in the water, with a climbing capacity of 1,000 feet in three minutes. At an altitude of 1,000 feet a fire thirty or forty miles away is distinctly visible. I usually am flying every evening around 6 o'clock and I always reach an altitude which enables me to see about forty miles in every direction, and if I do see indications of fire I can report to the forestry headquarters at Trout Lake within three minutes.

D. W. Griffith, former State Forester of Wisconsin, reports having made a recent ascent with Mr. Vilas when they detected a fire. By communicating with the rangers when they came down they found that it was a settler doing some clearing. The hydro-aeroplane will reach the place of a fire in only a few minutes, where otherwise hours would be consumed.

* * * * *

Federal Building Construction Reform. In an order recently issued by Secretary McAdoo to the supervising architect of the U. S. Treasury Department a reform is inaugurated. Heretofore the amount spent in building a postoffice or custom house has depended much more upon the energy and political strength of the congressman from the district in which the building was to be located than upon the needs of the government. The result has been the erection of costly and elaborate stone buildings in country villages, while localities where improved facilities were greatly needed received inadequate buildings or none at all. It is said that many postoffice buildings have been erected at a cost of $50,000 to $150,000 in towns where the total postal receipts would not pay the cost of maintaining the building after completion. Under the order recently issued postoffice buildings are divided into four classes—A, B, C and D. Class A buildings may be erected in places where annual postal receipts are over $800,000. Such buildings are to have marble or granite facings and to be fireproofed throughout, and when the locations for the buildings justify it they are to have elaborate architectural decorations. Class B buildings may be erected in cities having postal receipts of from

$60,000 to $800,000; they are likewise to be fireproofed throughout, but to have limestone or sandstone facing and less expensive interior finish and decoration. Class C buildings are to be erected in towns having postal receipts of from $15,000 to $60,000 and are to be of brick with stone or terra-cotta trimmings. The floors are to be fireproof, but the roof not necessarily so. Finish and decoration are to be more inexpensive than for Class B buildings. Class D buildings are designed for towns having less than $15,000 annual postal receipts. Such buildings need have only the first floor fireproofed, and should be structures which business men would consider a reasonable investment. Plans of buildings hitherto constructed are to be used in designing if they are consistent with the foregoing requirements. Standard specifications and standard details are to be prepared to economize in architectural and engineering work in connection with such buildings. The policy outlined has already been followed by the Treasury Department in the purchase of postoffice sites. Of 303 sites for federal buildings authorized March 4, 1913, only 136 have so far been acquired, and the department has limited its purchases to towns where it is believed construction of a federal building is justified. The most zealous fire-preventionists are inclined to feel that all government buildings should be of Class A or Class B construction no matter where their location, but freely admit that the above order registers a considerable federal advance in the right direction.

* * * * *

Rules for Frame Buildings in New York. The detail of the work of Rudolph P. Miller, (president of New York Chapter, N. F. P. A.) in the revision of the New York building code, which arduous task he is now conducting for the city, is indicated in the rules for frame buildings of which section of the code Mr. Miller furnishes the following summary:

Following the recommendations of previous proposed revisions, the areas of frame buildings are limited to 4,000 square feet when occupied as residence buildings, 2,000 square feet when occupied otherwise, except that when only 1 story high the limit in either case is increased to 5,000 square feet. Frame buildings, either of a temporary nature within the fire limits or of a permanent nature anywhere, are restricted to 80 per cent. of the lot area not covered by brick or fireproof buildings. The provisions of the present code to secure substantial construction in the framework of frame buildings are repeated. The exterior walls within 3 feet of any property line, except the street front, must be filled in with brickwork or other fireproof material. Party walls, if of frame construction, must be filled in for a thickness of 4 inches, and, when buildings are built in rows, at least one party wall in every 50 feet must be of brick 8 inches thick. The filling of side walls must extend to the underside of the roof beams, and party walls must extend the full depth of the building. In frame construction within the fire or suburban limits, when such is permitted, fire stops must be provided in all walls and partitions at the floor levels by filling in with fireproof material. The roofs of frame buildings that may be permitted within the fire limits must be of incombustible materials and within the suburban limits must be of incombustible materials if the building is located within 25 feet of any lot line or nearer than 50 feet to another building. Towers of frame construction are permitted over the 40-foot limit in the case of residence buildings, but not to a greater extent than 10 feet above that limit nor covering a greater

area than 15 per cent. of the area of the building. The greatest horizontal dimension of any such tower above the 40-foot limit is limited to 15 feet. Outside of the fire and suburban limits church spires of frame construction are permitted to a height of 75 feet. All towers, however, must be covered on the exterior with approved incombustible materials. Piazzas of wood are permitted on any residence building within the fire limits under the same conditions as are fixed at present, namely, a limitation of 8 feet in width and 1 story in height. In connected houses the ends must be shut off by 8-inch brick walls. The roofs of piazzas must be covered by incombustible materials. This doesn't prohibit larger piazzas outside of the fire and suburban limits. Sheds of wood are permitted within the fire limits and suburban limits if they are open on one side, are not more than 15 feet in height, do not cover an area of more than 2,500 square feet and are not placed nearer than 4 feet to a lot line. Outhouses of wood, in connection with residences, are permitted within the fire or suburban limits when they do not exceed 8 feet in height nor more than 150 square feet in area. Sheds and outhouses must have the roofs covered with incombustible materials. Fences of wood are limited to 12 feet in height.

It would not seem as if the lumberman can reasonably complain of the severity of these restrictions, which do not prohibit a liberal use of wood where the danger of ready fire communication is not present.

* * * * *

Fire Losses in New York City. Fire Commissioner Robert Adamson, of New York City, reports that for the first six months of this year there was a reduction of $1,132,112 in the loss by fire as compared with last year and a reduction of 77 in the number of fires. There was a remarkable reduction in the number of cellar fires, owing to the system of monthly inspections by members of the uniformed force. There was an increase in the number of fires in private homes, due to acts of carelessness of individuals, a source of fires it is impossible to eradicate except by educating the people to better habits. The semi-annual reduction shown in the fire loss amounted, in Manhattan, The Bronx and Richmond, to $590,657, and in Brooklyn to $542,455. In Manhattan, The Bronx and Richmond the number of fires for the first six months of the year was precisely the same as for the same period last year, while in Brooklyn and Queens there were 77 fewer fires. There were 1,331 fires in dwellings and 3,227 fires in tenement houses, a total of 4,558 in houses out of a total of 7,023 fires in all. There were 490 fires in factories and there were 24 fires in schools and colleges. In furnished room and boarding houses there were 79. There were 85 garage fires, 8 hospital fires, 61 hotel fires, 21 theatre fires, 232 fires in lofts and business buildings, 13 moving picture fires, 14 lumber yard fires, 7 fires in churches and 51 fires in offices. The fire commissioner says:

The great number of fires continue to occur in the people's homes. Out of a total of 7,023 fires, 4,698 of these occurred in dwellings, tenements, hotels, boarding houses and rooming houses. They are practically all traceable to careless smokers, to carelessness with matches, with gas jets, furnaces, cleaning fluids, ashes, etc. If we can only get the people to help we can have an amazing reduction in the number of fires. The reduction we have had this year in the face of a rapidly increasing population and the extraordinary reduction in the fire loss show the effective work of the Fire Prevention Bureau, but the reduction of fires in private homes, territory which we have no authority to reach, must come from the people themselves.

The New York authorities must feel particularly helpless before such festivals as the Jewish New Year "Yom Kippur," which comes in September. There were this year fifty-one alarms for fires caused by upsetting candles during the twenty-four hours ending at 7 A. M. Saturday, September 18th, while the week previous there were twenty-nine such fires. Fortunately the fire department prevented any serious fires, although in a few instances there was a considerable loss. A better idea of the frequency of these fires may be obtained by considering that in Brooklyn alone, nine fires were started in the single hour between 6 and 7 P. M. or an alarm every six and two-thirds minutes. This is certainly a situation demanding attention, but how is the fire prevention bureau or any other authority to forbid a man to light a candle in his own house?

* * * * *

Widening a Boston Street—on Paper A problem in municipal arithmetic was recently solved by the street commissioners of Boston, Mass., when they found a way to permit a local building syndicate to erect a 125-foot building on State street where the width of the street is only 40 feet. A city ordinance requires the skyscraper limit in Boston shall be 125 feet and no buildings may be erected to a greater height than 2½ times the width of the street on which it fronts. This syndicate planned to tear down a block of small buildings at State street and Chatham row, opposite the new Custom House tower and erect a $1,000,000 structure. The ordinance interfered, however, for it would permit them to build only up to 100 feet.

The syndicate wanted a 125-foot building. The city wanted this $1,000,000 worth of additional property in the downtown section. Consequently the mayor put the proposition up to the street commissioners.

They found, on looking at their maps, that the site for this property is opposite McKinley square, in the centre of which is the new tower, and which is several hundred feet in width. Therefore the street commissioners voted to relocate the line of State street far enough within this square to make the total width of State street more than 100 feet at this point. Actually the street is not widened, although its line on one side has been moved back more than 60 feet. This relocation, being made by moving the line down McKinley square, does not affect any buildings in the neighborhood and consequently does not cost the city any money. And the syndicate, with this frontage before its property, can now go ahead and erect its $1,000,000 building.

* * * * *

Testing Theatrical Scenery. Fire Chief Bunker of Cincinnati had some interesting things to say at the convention of the International Association of Fire Engineers last month on the testing of theatrical scenery, curtains, drops, etc., which traveling companies may bring into town. He said:

> When we first started the systematic testing of scenery several years ago, there were in Cincinnati 19 regular theatres and 69 moving-picture houses. All these, with the

exception of a few regular houses, had no fire protection whatever in the way of extinguishers, pike-poles, axes, barrels of water or fire buckets. Fireproofing was unknown to some of the managers and owners of theatres. The work of inspecting, however, proved to a great many of these managers that the sanitary condition improved with the necessary fire protection. For example, dust had accumulated in the rigging lofts of some of the theatres from the time that they had been built. The work of removing all the dust from the rigging lofts and cellar ways was ordered, and all unprotected woodwork in the rigging lofts and cellar ways of all regular theatres and moving-picture houses was ordered fireproofed. The result at the end of the year was that in all these theatres and picture houses there was installed the necessary equipment for fire protection, and they had fireproofed all unprotected woodwork. During the year 14,000 pieces of scenery belonging to shows entering the city for a week's run were fireproofed and tested. The efficiency of fireproofing was demonstrated on several occasions—once at an evening performance of one of the leading houses when a piece of scenery was charred by crossed electric wires. It was agreed by all who saw this charred piece of scenery that if it were not for the fact that the scenery in the house had been fireproofed that day a serious fire would have resulted. On another occasion at an evening performance in a moving-picture house a piece of defective electric wiring charred the woodwork in a remote part of the cellar but without starting a blaze, owing to the fact that the woodwork had all been fireproofed ten days previously. Part of the plan we have adopted here is to give theatres a thorough inspection before the season opens, to see that all house scenery is fireproofed and that the fire hose, standpipes and all fire extinguishers are in good working condition. By inspecting we have discovered hundreds of pieces of scenery stored in the fly galleries that had become covered with dust. Often the managers have had them taken out of the theatres and stored elsewhere, thus eliminating a serious fire hazard. Our tests of theatrical scenery run from 3,000 to 3,500 pieces per month, about one-third of which stand the ordeal. These have been among the chief results of our work and fairly show the necessity and importance of inspecting and testing. However, the main point which I wish to urge is the advisability of adopting a uniform and standard test by the fire departments of all our cities for use on scenery, and especially on theatrical scenery and equipment, since theatrical scenery to a much greater extent than that used in concert-halls and moving-picture houses is on the move from place to place, and consequently subject in each place to tests very much in kind and severity. There are two chief methods of testing—the match and the blow-torch. In Cincinnati we use a 3-inch gasoline blow-torch and we find it by far the most satisfactory for the reason that it can be applied to flat surfaces and other parts of the scenery, where the mere flame or match test would prove utterly inadequate. One can readily see what confusion and trouble are brought about when a set of scenery which has successfully passed a less severe, or at any rate, a different test in another city reaches Cincinnati and is not allowed to go on without refireproofing. We are very fortunate here in Cincinnati in having men at the head of our various theatres who back up the firemen completely in their tests and insist upon a full compliance with our requirements, and in case of refusal on the part of the show manager or advance agent, cause the scenery to be removed from their houses. If this were not so matters would be much worse, but even as it is it frequently happens that the traveling show manager or advance man will become disagreeable when his scenery is not declared O. K. He will argue, perhaps, that his scenery passed the test in Boston, New York or Chicago, or whatever other city he last came from, and naturally he cannot, or will not, be made to see the true state of the case, namely, that a different test was applied in that other city, for instance, or that the fireproofing compound he used had lost its strength or turned to powder and been shaken off in transit. Now many disagreeable features of this business of scenery inspection would be avoided if, especially in our large Eastern cities, whence most of the shows start out, there were some well-understood and agreed-on test; and not only would this have the advantage of doing away with much trouble and unnecessary argument, and even in some instances law-suits, but it would tend to greater efficiency in fire prevention and be much more just to the owners and managers of shows by raising a clear and definite standard of testing to which they might more surely

conform, and thus do their part towards the protection of the great public of which the fireman is the particular guardian. One good method, perhaps, would be for the fire chiefs throughout the country to have an official stamp, to be placed on scenery which had successfully stood the blow-torch or some other standard test to be agreed upon—the stamp to show the date and place of testing.

The suggestion made by Chief Bunker is excellent, and our active member, the International Association of Fire Engineers, seems the logical body to work out and agree upon these tests to be regularly made by all the fire chief's in their respective cities.

* * * * *

Peabody Parochial School Fire. Simultaneously with the publication of the N. F. P. A. special bulletin on Fire Protection in Schools came the horrible news of the death of twenty-one little girls in the fire of October 28th in St. John's Roman Catholic School at Peabody, Mass. The usual investigations and accusations and refutations are being made, but the twenty-one little girls are dead and the distracted parents have not had even the comfort of identifying their own. The lives of the twenty-one little girls represent the human cost of the ignorance of those who conducted the school. The little girls were burned upon the altar of this ignorance. Any wooden interior, with unprotected floor openings, with storage of sweepings and waste inside it, and basement with its heating apparatus unisolated is a potential death-trap. Everyone knows this who knows or cares to know anything about fire protection. That seems to be all there is to say about the St. John's school fire. The twenty-one little girls cannot be restored to life.

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A New Educational Movie Reel. The National Motion Pictures Company of Indianapolis, manufacturers and distributors of motion picture films, slides and machines for business and educational purposes, suggested to the Secretary of the N. F. P. A. a year or two ago that an educational film showing the common causes of fires should be prepared and used under the auspices of our Association. The cost of producing such a film, running from $1500 to $2000, seemed prohibitive in consideration of the slender revenue of the Association, not withstanding the obvious value of motion picture education. The greatest difficulty in all of the N. F. P. A. propaganda has always been to reach the man in the street who is unorganized and who cannot therefore be reached through the various associations accessible to our educational efforts. It was suggested to the National Motion Pictures Company that they themselves undertake the production of such a film in the scenario of which the N. F. P. A. would co-operate, the fact of such production to be communicated in every available way to our members. After several months consideration of the matter and encouraged by the result of a similar undertaking in the production of an educational film illustrating maternal nursing for the prevention of infant mortality which found special favor among the State Boards of Health of America, the company decided to

bring out such a picture visualizing the causes of common fires in the hope that the fire prevention agencies of the country would respond by the purchase and use of the film. The work of producing the film is now under way and a circular giving the synopsis of the pictures is going forward to our members. The reel will run for twenty minutes, its approximate length being 1000 feet. The price quoted for the reel is $225. It is of course to be printed on slow-burning stock.

* * * * *

Automatic Sprinkler Data. Our members particularly interested in the efficiency of automatic sprinklers as related to the several sources of water supply will make no mistake if they carefully study the statistics worked out diagrammatically for this issue of the QUARTERLY by our Superintendent of Fire Record, Mr. R. O. Dawson. We do not believe there is available anywhere else such interesting, accurate and educative data on this subject, as outside of the office of the N. F. P. A. the fire reports are not available upon which such data may be based.

"Why are children so much worse than they used to be?"

"I attribute it to improved ideas in building construction."

"How so?"

"Shingles are growing scarce, and you can't spank a boy with a tin roof."—*Life.*

THIS is YOUR
war; a moral war: a war to SAVE life and property; not to destroy it!

MEMBERS' ACTIVITIES.

President Charles E. Meek delivered an address on "The Safety Idea as related to Credit-granting," on the first day of the fourth annual safety congress of the National Safety Council at Philadelphia, October 19th to 21st. A number of our members are especially active in the work of this unusually effective organization, two of them, H. W. Forster and Lew R. Palmer being on the Program Committee and Committee on Arrangements of this year's congress, as well as members of the Executive Committee of the Council.

* * * * *

Secretary Franklin H. Wentworth was a speaker at the conventions of the International Association of Fire Engineers, Cincinnati, O., September 2nd and the Fire Marshals' Association of North America, Chicago, September 10th. He attended the four-days' meeting of the National Convention of Insurance Commissioners, at Del Monte, California, beginning September 21st; addressed the convention of the Pacific Coast Association of Fire Chiefs, San Francisco, September 27th, and spoke under the auspices of the Library Committee of the Board of Fire Underwriters of the Pacific, in the rooms of that body on October 11th. On October 6th, he addressed the World's Insurance Congress in the municipal auditorium, San Francisco, and on the 13th presided at the Fire Elimination Day exercises of the congress in the Court of the Universe, Exposition grounds, where the National Fire Protection Association was officially presented with a bronze plaque on behalf of the officers of the Panama-Pacific International Exposition.

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On invitation from the San Francisco Fire Commissioners, Secretary Wentworth sat with that body at their meeting on October 13th and

explained at length the system of organized property inspection now carried on by the uniformed men of the fire departments of many Eastern cities. The commissioners favor such a plan for San Francisco and advocates the printing of the special report on San Francisco recently made by our member C. Heller, Consulting Engineer, which report indicates forcibly the local need for such organized inspection.

* * * * *

It is interesting that the first city on the Pacific Coast to inaugurate an organized fire department inspection service with a special officer in charge is Portland, Oregon. Jay W. Stevens is the efficient chief of the Bureau of Fire and the organization, as well as Chief Stevens' appointment, is the result of the five years' persistent efforts of the Fire Prevention Committee of the Portland Association of Credit Men headed by our devoted member Mr. E. M. Underwood, a prominent hardware merchant. On fire-prevention day this year, October 9th, the Portland Chamber of Commerce gave a luncheon to Chief Stevens and his inspectors, officially pledging its support to his efforts in improving the fire record of Portland.

* * * * *

Our Portland, Oregon, members evolved one item in their clean-up campaign which is calculated to heighten the efficiency of school children's work as fire-wardens, by touching the individual pride of their parents. Each pupil was given a list of questions on the house-keeping and fire hazards of his own home, and asked to report to the school. It is obvious that no pupil likes to bring in a bad report, and no parent cares to subject a child to such humiliation. The plan was effective in Portland, many a house-cleaning being precipitated to permit of an honest, favorable report.

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Chief Officer Bernard A. Westbrook of the Calcutta (India) fire brigade, writes in warm commendation of the N. F. P. A. plan to assess the cost of fire extinguishment upon those who ignore fire prevention orders, and says he hopes to have a law like that of Pennsylvania embodied in the Calcutta Municipal Act.

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Lee McKenzie of the Washington Surveying and Rating Bureau, Seattle, is getting out a little monthly leaflet called "Fire Facts," which should be of considerable value in bringing the people of his section to understand common fire hazards.

* * * * *

Members who were especially interested in the conference of building inspectors and commissioners, whose first session was held under N. F. P. A. auspices at the time of our last annual meeting and which was continued independently at the Hotel Astor on the following day, will

be glad to know that the minutes of the conference have been published by the official stenographer, J. G. Needham, 1973 East 14th Street, Brooklyn, N. Y., of whom copies may be had. The book contains interesting discussions on the subjects of floor loads, hollow tile for walls, enclosure of stairways, automatic sprinklers, etc., from the points of view held by building department officials.

* * * * *

The new fire prevention commissioner appointed under the recently enacted state law of Tennessee, Charles W. Schuyler, has lost no time in taking up actively the details of the work for which he is responsible. In connection with an active educational campaign Commissioner Schuyler has recently issued regulations compiled by his department governing the storage of inflammable liquids, explosives, etc., dry cleaning establishments, motion picture houses and other hazards. Fire Prevention Commissioner John A. O'Keefe of the Metropolitan district Boston is also continuing his educational work with vigor. Both of these officials, being the first to hold office under the laws creating their departments, bid fair to establish traditions from which possible successors will find it difficult to depart.

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Chairman Scofield of the Committee on Automatic Sprinklers is taking up actively the matter of ice formation in sprinkler piping in refrigeration sections of warehouses, packing houses, etc. Numerous reports of such freezing, compiled by various active members, indicate the importance of this matter. Chairman Scofield has issued a special blank and letter calculated to be helpful in getting a thorough investigation of the subject under way.

* * * * *

Chairman Thomas R. Weddell of the Committee on State Fire Prevention Associations has issued a bulletin to the associations represented upon his committee reporting the fact of a conference of representatives of the state associations in Chicago at the time of the meeting of the Fire Underwriters Association of the Northwest. The principal matter discussed, to which interest was given by the presence of Mr. F. M. Griswold, was the work of standardizing hose couplings and hydrant fittings, in respect to which such a favorable beginning has been made by the Ohio association and whose procedure the Illinois association may follow. Chairman Weddell states that a definite plan will be evolved for a larger similar conference in October of next year.

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The Eastman Kodak Company of Rochester has issued an attractive pamphlet entitled, "Suggestions on Fire Protection," in which the matter of the economic value of automatic sprinklers is specifically treated.

The engineer compiling the booklet, Mr. J. F. Ancona, makes out a good case for money-saving by the general adoption of this kind of protection. Copies of the pamphlet may doubtless be secured without charge by addressing the Eastman Kodak Company.

* * * * *

As the State of Oregon has no state fire marshal and is therefore deprived of the educational work commonly done through such an office, the Insurance Commissioner, Harvey Wells, has at the suggestion of the Governor compiled a fire prevention bulletin of thirty-two pages, intended for general circulation throughout the state and calculated to instruct the inhabitants of Oregon in fire prevention. It is a handy little booklet, written in non-technical language, and should accomplish its purpose. Copies may be obtained by addressing the Insurance Commissioner at Salem, Oregon.

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The New York Chapter held its first meeting of the season at the City Club, 55 West 44th Street, on October 18th, President Miller presiding. The speaker of the evening was Mr. H. F. J. Porter on the subject, "The Importance of Building Exits." A discussion followed in which Messrs. F. T. J. Stewart, Robert D. Kohn, D. Everett Waid, John Kenlon, Joseph O. Hammitt, A. L. A. Himmelwright, Mason R. Strong, Ira. H. Woolson and other members participated.

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Chicago Chapter celebrated Fire Prevention Day by joint exercises with the City Club Friday noon, October 8th. Mr. Clarence S. Pellett spoke on "The Danger of a Conflagration in Chicago Today," which was followed by Mr. James E. Latta's talk on "Fire and the Fight Against It," illustrated by motion pictures of the organization and work of Underwriters' Laboratories, Inc.

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Mr. E. S. Clayton of Newark presented a paper before a recent meeting of the New Jersey Field Club upon the subject of "So-Called Sprinkler Failures." Mr. Clayton showed conclusively that when automatic sprinklers fail to accomplish what is expected of them there is always a definite and specific reason for the so-called failure.

* * * * *

Mr. John R. Freeman, the official delegate of the N. F. P. A. to the International Engineering Congress in San Francisco in September, presented an admirably comprehensive paper on "The Fire Protection of Cities." Mr. Freeman was one of the earliest advocates of automatic sprinkler protection, and emphasized the value of this protection in his San Francisco address.

A. Lindback, Fire Commissioner of Manitoba, delivered an interesting address to the Provincial Association of Fire Chiefs at Ottawa, Ontario, in September, advocating regular organized inspection by uniformed firemen and urging co-operation with the N. F. P. A. by all firemen as associate members.

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The prizes offered by the National Municipal League for the best essay submitted on Fire Prevention during the year were won by high school students of Milwaukee and Louisville. Miss Margaret Reick of the Milwaukee high school and Robert F. Matthews of the Louisville male high school won the first and second prizes of thirty and twenty dollars respectively. The judges were our members, J. O. Hammitt, chief of the Bureau of Fire Prevention, New York, and J. S. Mallory, former fire marshal of Philadelphia.

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The Marathon Paper Mills Company of Rothschild, Wisconsin, is issuing an interesting series of safety bulletins in the interest of its employees. The bulletins are well and attractively printed and illustrated, and they contain many valuable suggestions both for the factory and the home. A recent issue is devoted wholly to fire hazards.

* * * * *

The officers have appointed a Boston Committee to replace the former Boston Chapter. The following is the personnel of the committee: Chairman: W. O. Teague, Members: C. M. Goddard, R. L. Gay, Gilbert A. A. Pevey, Gorham Dana, Nelson Whitney, H. V. Thayer, Frank I. Cooper, L. Lloyd Greene, G. S. Lawler. The committee comprises most of the members who were especially active in the chapter work and it is believed the committee form of organization will be much less unwieldy and will make for much greater efficiency in handling Boston matters.

FIRE PROTECTION AND CREDIT

By Charles E. Meek
Past-president National Association of Credit Men.

Today the relation of fire insurance and fire protection to credits is on this basis: Insurance reinforced by fire prevention methods stands first; insurance, alone, ranks next; the use of fire prevention methods without insurance is third; and the absence of both insurance and fire prevention methods removes every excuse for the extension of credit.

I DON'T CARE WHERE I THROW MY CIGARETTE
DOES IT LOOK LIKE THIS UNDER YOUR CELLAR STAIRS ?
SHINGLE ROOFS MADE 15,000 SALEM PEOPLE HOMELESS IN ONE DAY
WHICH ASH BARREL IS YOURS?
HOW SOON WILL YOU GET RID OF YOURS
THIS ONE IS SAFE
THIS STARTS FIRES
USE METAL
USE SLATE
CARELESSNESS AND NEGLECT CAUSE MOST OF OUR FIRES
FIRE PREVENTION COMMITTEE — SALEM CHAMBER OF COMMERCE & CIVICS
FIRE PREVENTION

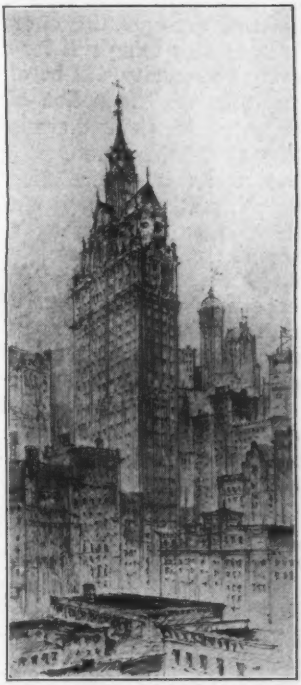
Photo from C. P. Faunce, Member N. F. P. A.

SALEM FIRE PREVENTION FLOAT.

The forward ash barrel was of wood and had a smudge in it so that the smoke stewed out of the cracks. The rear ash barrel was of standard galvanized iron. Under the stairs was an accumulation of rubbish. The man sitting on the stairs is smoking a cigarette. By his foot is a wooden keg. There was an arrangement in this with a spark plug operated by a push button on the steps. From time to time the smoker would apparently throw his cigarette into the tub, but really a little black powder, (pressing the button at the same time) so that it sent up a flare, to his apparent astonishment. The other items are self-explanatory.

"Some High Church"

The Rev. F. B. Upham has proposed to celebrate the 150th anniversary of Methodism in the United States next year by erecting a 30-story office building topped by a church and a flaming cross. The site chosen is that of the "Old John Street Church" in New York city. Founded in 1766, built in 1768 and several times rebuilt, this oldest of American Methodist meeting houses is one of the few church buildings which has clung to lower Manhattan. The plans for the new structure are by McKenzie, Voorhees and Gmelin and the photograph here reproduced is by courtesy of the *Christian Advocate*.



Personal Liability Laws.

National Convention of Insurance Commissioners adopts unusually forceful report.

The following report and resolution were presented to the National Convention of Insurance Commissioners at its Convention at Del Monte, California, September 22nd, 1915.

We ask your endorsement of a special effort the National Fire Protection Association is now making in the field of legislation. It is an accepted principle of the common law that a man is liable to his neighbor for injury to the latter resulting from his carelessness or neglect. Owing to the common American assumption that every man who has a fire is an unfortunate to be pitied, this liability has not yet been recognized

in relation to losses from easily avoidable fires. We therefore desire the active co-operation of our members in inducing those who suffer from such fires to bring suit for the recovery of damages. One such suit in every community will be of incomparable educative value and at once result in the elimination of a surprising number of conspicuous local hazards. No civilised community should expect its firemen to risk their lives in fighting fires easily preventable; enough danger will always be encountered in extinguishing those not easy to avoid. For many years we will continue to have disastrous fires, and fires of great magnitude in those cities in which wooden construction still makes sweeping fires possible. The aggregate fire loss cannot for sometime be taken as the direct measure of our success in fire prevention. It is the decreasing number of fire alarms that is to be the significant factor, and nothing will reduce the number of fire alarms so radically as the fixing of personal responsibility therefor. The utmost achievements of fire fighting science are crippled and balked by the habits of a people encouraged in irresponsibility toward the common safety. The attention of such a people cannot be attracted and a correction of their mischievous habits achieved by any ordinary methods of polite education. They must be made responsible for their acts of trespass. A man who has a preventable fire picks the pockets of his neighbors either through the medium of fire insurance, or an unjustified use of the public fire department which all must support. Fire departments are not maintained to protect a man from the results of his negligence, and when he calls upon the city in any such case he should be made to pay for the service. The safety of a whole city may be jeopardized at a critical moment by the diversion of the attention of the fire department in the run to a fire which should never have occurred. It is the careless and indifferent citizen who will not protect himself by decent housekeeping, who makes constant inspection of his premises by the firemen so necessary. He makes imperative a larger fire department and lays his neighbors under assessment to maintain it. Is it not then peculiarly just when the department issues an order and a fire results from its non-observance, that the offenders should pay to the city the full value of the services of the fire department and any damages in person or property resulting thereto in extinguishing or attempting to extinguish such fire? We believe that it is, and it is legislation to this end which the National Fire Protection Association is seeking, and for which it asks your co-operation. There is already such provision in the charter of the City of Greater New York, and during the current year the legislature of the State of Pennsylvania and the City Council of the City of Cleveland, Ohio, have enacted the same into law. These cities and this state are therefore the leaders in a movement the justice of which is irrefutable and which is bound to exert a profound influence in correcting the defects of character which make for America so unfavorable a showing among the more prudent nations of the world.

In closing this committee desires to present for your consideration the following resolution:

WHEREAS: The fire waste of the United States and Canada is greater in proportion than that of any other countries in the world; and

WHEREAS: A majority of the fires causing this waste are easily preventable, being due to the individual carelessness, neglect and irresponsibility of citizens and others; and

WHEREAS: Laws, ordinances and regulations exist and inspection orders are issued for the reduction of fire hazards and the safeguarding of the common safety;

It is hereby RESOLVED that the National Convention of Insurance Commissioners is in favor of state or municipal legislation designed to assess upon individuals, firms or corporations the cost of extinguishing or attempting to extinguish all fires occuring in the premises of the same, whenever such fires are the result of failure to comply with any law, ordinance, lawful regulation or requirement of any state or municipal authority enacted or made for the prevention of fire, and that the campaign of the National Fire Protection Association for this object is hereby commended and endorsed.

COMMITTEE ON PUBLICITY AND CONSERVATION.

O. K. STABLEIN, South Dakota, Chairman,
JNO. S. PATTERSON, Texas.
A. L. WELCH, Oklahoma.
E. R. HARPER, Colorado.
E. J. CARTER, Maine.
W. C. TAYLOR, North Dakota.
JOHN JAMES, Utah.
WM. E. MILLSAPS, Louisiana.
WM. F. DUNBAR, Tennessee.

Note: The above report and resolution were unanimously adopted by the Convention except for one negative vote, that of Hon. J. S. Phillips, Insurance Commissioner from New York State.

The True Cause.

Hon. John T. Winship, insurance commissioner of Michigan, (member N. F. P. A.) answering a letter of complaint to his department on the subject of high insurance rates, uses the following paragraph in the course of his reply: "I am of the opinion that fire insurance rates are proving a heavy burden to our people, but, from the study I have given the subject, I am convinced that we will never reach a rate satisfactory to our people until we have learned the lesson of fire prevention and needless fire waste, and until our juries co-operate with the fire marshal's bureau in its efforts to wipe out, or at least diminish, the crime of arson and incendiarism."

Picric Acid: Its Manufacture and Liability to Explode

By Thomas Osborne.*

Factories in which picric acid is made are subject to explosions the nature of which is somewhat obscure. Several have occurred within recent years involving serious loss of life. In the consideration of the most probable cause of accidents, two separate and distinct questions are suggested for consideration; first, the means by which the heat necessary for ignition can be produced, and secondly, explanation of the conditions or circumstances by which, contrary to all preconceived ideas, the ignition should at once develop into explosion, instead of merely resulting in comparatively harmless combustion. Works for the manufacture of picric acid may consist of two groups of buildings, one in which the wet process of manufacture is carried on and another in which the acid is dried, sifted, packed and stored.

Process of Manufacture.—The process of making picric acid consists broadly in mixing carbolic acid with strong sulphuric acid, diluting this sulphonate with water and then running it slowly into nitric acid. The mixture is allowed to cool when the crude picric acid crystallizes out and is subsequently purified by re-crystallization. After thorough washing with water to remove all traces of free nitric and sulphuric acids, the material is whirled in a centrifugal or hydro-extractor to remove the bulk of the water and is then removed to the drying shed, where it is spread on glass beds heated by steam until all moisture is removed. It is then transferred in large open drums to the sifting-room where it is ground and passed through a revolving sieve, whence it is taken to the packing room and packed in barrels. The large crystals which fail to pass through the sieve are ground in a crushing mill and then added to the rest.

Experience and records suggest that it should be impossible that an explosion of unconfined picric acid should occur, provided that the quantity in any one building is limited to a moderate amount and that no picrates are present. Under ordinary conditions the risk is one rather of fire than of explosion, consequently the buildings are not usually placed very far apart; as they undoubtedly would be if explosion were an ordinary risk. In the case of one explosion the whole quantity of loose picric acid appears to have detonated without warning and to have communicated sympathetically to other buildings in which unprotected acid was present. The

*From the Chemical Engineer.

hitherto accepted theory that picric acid cannot be exploded by friction or heat, unless confined, is open to doubt. One process of the manufacture may be said to be never entirely free from risk; that is, the operation of grinding the larger crystals of picric acid which have failed to pass through the sieve. To effect this the picric acid from the drying shed is usually, by means of a hopper, introduced into a revolving sieve or reel turned by hand; all the material passing through the meshes of the sieve falls on the floor and is removed by raising a hinged shutter at the floor level in the casing enclosing the reel. Such of the crystals as are too large to pass through the sieve are removed and transferred to the grinding mill. This mill is constructed of iron and generally consists essentially of a pair of revolving discs to which the material to be crushed is fed through a hopper. The machine is so made as to be easily taken to pieces for cleaning purposes and put together again, a process generally done daily at the end of the day's work; it can be cleaned by means of a handbrush and cloth. The operation of sieving is simple enough and presents no dangerous features; moreover picric acid is by no means easy to ignite, especially when the reel is turned by hand; so that there appears to be little probability that accidents can occur at this stage. There seems to be a much greater probability that ignition may occur in the grinding mill. In one factory no less than three fires have occurred within the last few years during the operation of grinding the dry acid. The mere process of grinding is not necessarily dangerous; that may be inferred from the fact of the immunity experienced during the operation of drilling out the primer space in the solidified charges of picric acid filled into shells and ammunition, by means of power-driven steel drills, a method which has been employed in Europe for some time without the slightest accident. But because picric acid may be safely ground in an iron mill, that does not apply to nails, stones and other hard foreign bodies, which may accidentally find their way into the powdered material. In one case of a fire an examination showed that it was produced by the pressure of a nail in the machine. Apart from ignition there is explosion to be considered, which occasionally immediately follows and it seems quite possible from recent experience, that it may be desirable to modify to a very considerable extent the conditions under which the manufacture of picric acid is now carried on, so as to ensure the safety of those engaged in the factories. In the case of one disastrous explosion it was established beyond the possibility of doubt, that it was due not to picric acid alone, but to the presence of considerable quantities of lead and strontium compounds, which under the influence of heat and in contact with the melted picric acid led to the formation of lead and strontium picrates, both of which and more particularly the lead salt, are not only in themselves violently explosive, but are capable of detonating picric acid in contact with them. It is noteworthy that it is stated in books on the subject by chemists of the highest standing, that when suddenly heated, picric acid will explode; it is not possible to obtain confirmation of the statement in the actual experience of manufacturers, or from the accounts of accidents which have taken place, or from experi-

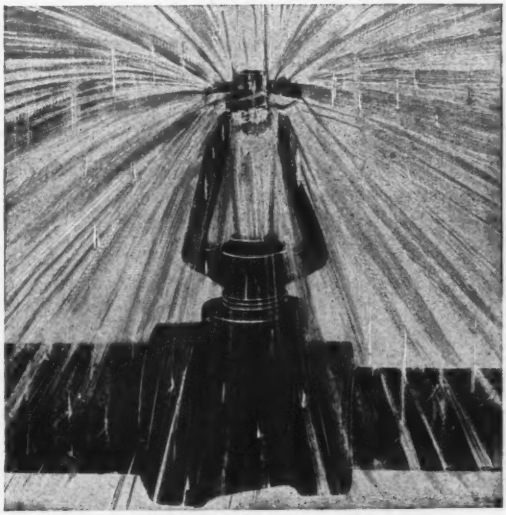
ments instituted for the special purpose of clearing up the point. In fact so far as experience, records and experiments go, they may all be said to furnish a very emphatic contradiction of the statements, that picric acid when unconfined can be exploded by fire. A case is recorded in which an iron vessel with a very small orifice and containing 25 lbs. of picric acid was placed in a reverberatory furnace, when the acid burned away without explosion.

On the other hand, it has been found quite possible to explode picric acid by a blow, but this blow must be of considerable force if the material is cold and of a character that could seldom occur in practice—all experience, in fact, seems to prove as surely as negative evidence can be said to prove anything, that it may be taken as a practical impossibility for picric acid to explode without giving sufficient warning by fire to enable anyone in the vicinity to escape, and that, moreover, a fire in its initial stages can be extinguished by water without much difficulty.

In Great Britain, as the result of explosions due to causes which have never been ascertained, picric acid is regarded as an explosive and a license has to be obtained for its manufacture, but conditions of a drastic nature are not imposed and no limit was placed on the quantity that may be present in a building. Some years ago a serious explosion occured in the north of England at picric acid works. It was suggested by experts after careful inquiry, that it occurred after a fire had been raging for nearly ten minutes and that it was probably due to the formation of picrates of lime from the mortar in the roof of one of the buildings that fell in; moreover, that it could not be stated with certainty that it was not caused by the picric acid alone, which was present in greater quantity than in any instance quoted to establish the contrary view. More recently the quantity has been limited, that may be present in any one compartment; 2,000 lbs. is now considered the maximum which may be allowed in one risk. It is also considered desirable to have sprinklers fitted to every compartment or building liable to contain dry picric acid, as the danger of a fire developing into explosion is considered so slight as to be negligible.

In an accident which occurred last December the explosion was not preceded by a fire, the flash and report were simultaneous and experts are extremely reluctant to accept the possibility that the explosion was due to picric acid pure and simple; had a fire been in progress for even one minute there might have been some justification for attributing the cause merely to the presence of a substantial quantity of the acid. There seems to have been no possibility that by any means or other a picrate could have become mixed with the acid, owing to the simplicity of the process of manufacture and the careful method of construction of the buildings. A possible cause of explosion is the presence of dust in the atmosphere; it may accumulate for a considerable period of time, then a combination of circumstances may disseminate it throughout the room; a strong wind from an unusual direction, a draught through an open door would churn it up, and there are the raw materials for an explosion. Explosions have occurred in flour mills, the danger of coal dust explosions

in dry and dusty mines is well known and even oil cake dust has not so very long ago led to a serious disaster. The fact that each molecule of picric acid dust contains all the elements of an explosive would of course tend to increase the violence of the explosion. Thus given the presence of a nail or stone in the grinding mill and a cloud of dust raised by some accident, then all the elements to produce an explosion are provided.



The Automatic Watchman That Never Sleeps.
It Does the Work.

There is hardly any variety of structure, whatever its occupancy, into which sprinklers have not been or cannot be introduced. The most elaborately finished department stores, as well as the plainest factories, hotels, schoolhouses, theaters, and even vessels, have been equipped. The principal Panama-Pacific Exposition buildings have been sprinklered. In some buildings the piping is concealed, but even where exposed it is not objectionably noticeable. How many customers notice the sprinklers in the stores?

A sprinkler in operating will throw 12 gallons of water a minute under 5 pounds pressure, 18 gallons at 10 pounds, 30 gallons at 30 pounds, 40 gallons at 50 pounds, 50 gallons at 70 pounds.

To give a better means of comparison, let us refer to rainfall. The greatest continuous rainfall for ten minutes recorded by the Weather Bureau office at Hartford averaged .076 inch per minute. From actual measurement the average distribution per minute on the floor 10 feet below a sprinkler operating at 25 pounds pressure was .0907. That is to say, the downpour from the sprinkler under average conditions is 1.2 times as heavy as our heaviest rainstorms. Under higher pressure it might be twice as heavy.— *Hartford Agent.*

Scuppers.

Suggestions for their Installation in Buildings.

The Committee on Uniform Requirements submits herewith to members a revised draft of the proposed regulations for scuppers, the original draft of which was submitted to the last annual meeting (See *Proceedings*, 1915, p. 483). The committee has considered carefully all criticisms and suggestions brought out by the discussion of the report, and all written communications on the subject filed subsequent to the meeting, and believes that the regulations below represent the best ideas for scuppers so far formulated:

Suggestions for the Installation of Scuppers in Buildings.

Efficiency.

Scuppers will be found most efficient when installed under the following conditions:

a. Floors should be water tight. In a fireproof building, special precautions should be taken to make the upper floor surface impervious. In case floors are of wood, a waterproof material satisfactory to the Inspection Department having jurisdiction should be installed, either on the surface or under the top floor. This material to be flashed to a point at least 6 inches above the floor level around all floor openings, walls, columns, etc.

b. Stairway and elevator door sills should be raised in case it is desired not to have the water flow down these openings.

Note:—Frequently stair and elevator shafts form a very desirable method of carrying off the water provided they can be properly drained at the bottom. Where properly located and arranged, such shafts may obviate the necessity of scuppers.

c. Substantial metal sleeves should be used around pipe openings and a water tight joint made between the floor and the sleeve. Such sleeves should extend at least 6 inches above the floor.

d. For best results, floors should be crowned to slope slightly toward the scuppers. A slope of 1 inch for each 20 feet is recommended.

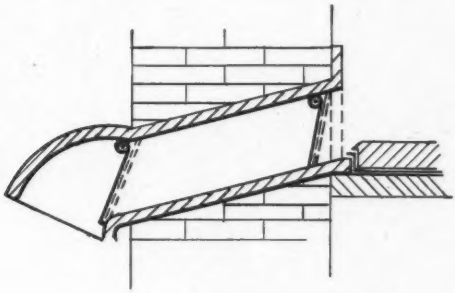
e. Goods susceptible to water damage should be skidded at least 6 inches above the floor.

f. Scuppers are at a disadvantage in buildings where the floor space is so filled with stock that the flow of water is badly obstructed. Also where scuppers are so placed that the water must travel a long distance from the point of discharge to the nearest scupper.

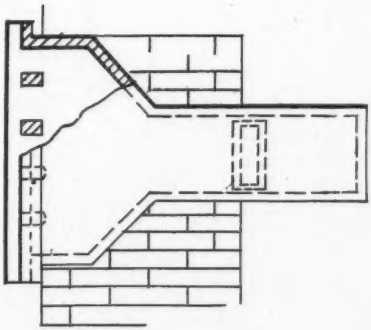
Exterior Scuppers.

1. To be designed with a large inlet tapering to a smaller outlet and arranged to extend a sufficient distance beyond the outside wall so as not to be readily sealed by ice.
2. The outer end to be so designed that strong drafts may be avoided and so that materials falling from above will not readily injure or clog the outlet.

3. Scupper to have a downward slope from inlet to outlet of at least 2½ inches per foot.
4. To be made of cast iron or some similar material sufficiently strong to withstand the strains and pressures to which it may be subjected in use, and in no case to be less than three-eighths inch thick.
5. To be so designed that the inlet will not be readily obstructed by storage. This may be done by making the inlet of a convex shape or by providing projections which will prevent stock from being stored close to the inlet.



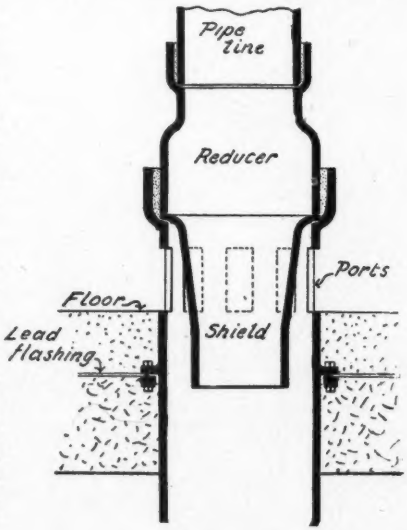
Exterior Scupper Section



Exterior Scupper Plan

6. Outside dimensions of inlet to be at least 12x4 inches, the long dimension being parallel to the floor.
7. Inlet to be screened by vertical bars, preferably of a removable type, not over 2 or less than 1 inch apart. Net inlet area between bars to be at least 36 square inches.
8. Discharge outlet to be at least 4x4 inches or its equivalent.
9. A metal valve or clapper to be located in the scupper near the outlet end.

10. Valve to be of bronze or similar non-corrosive material of sufficient thickness so that it will not be readily bent or broken, but not so heavy that it will require any material head of water to open it.
11. Valve to be designed so that it will close by gravity on a narrow seat in a positive manner.
12. Valve and seat to be of such material and design that a reasonably air-tight joint will be made even after extended use.
13. Valve to overlap the seat slightly to prevent corrosion or deposit from readily bridging across between valve and seat.
14. Valve to be loosely hung on a non-corrosive pin of bronze or similar material so designed that it will not be readily affected by corrosion or clogged by foreign material.
15. Scupper to be designed so that it can easily be set at floor level and so that the proper incline toward discharge will always be maintained when set in the wall.
16. Design to be such that it will not readily open, warp, or fuse when heated and will prevent the entrance of flame even under severe conditions.



Interior Scupper Section

Interior Scuppers.

17. May be of the flush or pipe type.
18. Inlet to have a net area of at least 36 square inches and to be in the form of slots not over 2 or less than one-half inch wide. Slots not to extend more than 4 inches above the floor.
19. To be so designed that water from floors above will not be discharged or spatter through scuppers on lower floors. This arrangement must not reduce the required inlet area at any point.
20. Flush scuppers to be protected by a substantial guard at least 6 inches high with the necessary slotted openings to fulfill requirement No. 18. This to prevent stock from being placed over the inlet.

Installation.

21. Pipe from interior scuppers to be large enough to care for the full discharge from at least two floors and never to be less than 4 inches in diameter. A separate pipe from each floor is preferable.
22. Scuppers to be placed so that the bottom of the inlet is not higher than the finished floor level.
23. A water-tight joint to be made between scupper and floor.
24. Interior scuppers to be piped to some drain or blind well, large enough to care for all the water that is liable to flow into same without allowing the water to back up.
25. Scuppers to be so located that there will be one for approximately every 1000 square feet floor area.

Note:—A scupper with an outlet of 16 square inches will discharge about 200 gallons per minute under a head of 5 inches.

The Brewing and Malting Industry.

PROCESSES, FIRE HAZARDS AND PROTECTION OF BREWERIES AND MALT HOUSES.

By J. Albert Robinson (Member N. F. P. A.)

Inspector Underwriters' Bureau of New England

INTRODUCTORY

Malting is the process of preparing cereals, usually barley, through germination, for purposes of conversion and fermentation.

Brewing is the process of preparing hopped fermented beverages, such as lager beer, ale, etc., the materials usually employed being barley-malt, hops and water.

Although the manufacture of malt is an industry by itself, it is closely associated with that of beer and many breweries now manufacture their own malt as part of the general business. There are only a few breweries in the New England States, however, where a malt house is operated in connection with the brewery. The brewery and malt house fires are considered as one class in the fire record classification of the National Fire Protection Association.

For convenience and quick reference this paper has been divided into five distinct parts.

PART I. Contains a summary consisting of a brief description of the processes involved in malting and brewing, an outline of the construction of a standard brewery, and a list of the principal manufacturing hazards with a brief suggestion for their treatment.

PART II. Gives a historical resume of the brewing industry, together with a consideration of the growth and present magnitude of the business. It also contains a discussion of the important features entering into the consideration of the moral hazard, economic, physical and financial.

PART III. Considers the Brewery in detail, with a sufficiently technical and complete description of the manufacturing processes involved to clearly demonstrate the special manufacturing hazards incident thereto, as well as the common hazards which obtain. This section also gives suggestions for the proper safeguarding and protection of breweries.

PART IV. Considers Malt Houses in a similar manner to that outlined above for breweries. Although logically the malt industry precedes the brewing industry, as a business it is of much less importance.

PART V. Analyzes the available fire records of brewery and malt house fires as found in The Chronicle Fire Tables, and the fire record files of the National Fire Protection Association with some miscellaneous statistics of interest, together with a loss record compiled from several available sources.

Part 1.

Summary.

The manufacture of beer involves two separate and distinct operations. First malting and then brewing. The object of malting is to so change the chemical composition of the contents of the barley grains as to render them soluble in water, so as to produce a liquid which can afterwards be subjected to fermentation. The process consists of steeping the barley in water in order to soften the husks; the barley swells in consequence and is then placed on the floor of the malt house. It begins to heat and to germinate, and from the proteids in the malt there is developed a curious substance called diastase, which has the property later of attacking the starch and converting it into maltose and dextrin, which are soluble products. When the process of germination has reached a certain point the barley grains are spread over a large floor and turned over from time to time to prevent over-heating, and germination proceeds. When it has reached the proper point, as determined by inspection, the malt is subjected to kiln-drying, the purpose of which is to terminate germination, because if it is allowed to go over, the result would be a garden of barley plants of no further value for beer making.

Next comes the brewing by which the malt is converted into beer. The crushed malt is extracted in hot water, when the diastase completes its action in changing the starch to dextrin and maltose. One part of diastase is sufficient for 200,000 parts of starch. After the malt has been sufficiently treated the solution is drawn off and this constitutes the wort. The remaining grains are subjected to a careful treatment of water to obtain as large a portion of soluble matter as possible, the worts are united, hops are added and the wort is complete. It is then rapidly cooled to the proper temperature, the yeast is added and fermentation proceeds. During the fermentation the yeast develops, attacks the sugar and liberates carbonic acid gas and alcohol. The rise of the carbonic acid gas through the liquid causes motion and the liquid is set to work. When the fermentation is complete the beer is drawn off and stored in suitable vats that it may properly age and undergo slow after-fermentation and ripening, and the liquid becomes clarified. The sediment of the yeast is found in the bottom of the vessels in the case of lager beer, while in the case of ale the yeast is found in the form of scum on the top. This indicates that the fermentation has been either bottom fermentation or top fermentation. Finally

the beer is filtered and placed in barrels or bottles, the latter being generally pasteurized. American beer usually contains from 5 to 6 per cent of extract or soluble food products. It contains from 3 to 6 per cent of alcohol.

CONSTRUCTION OF A STANDARD BREWERY.

Building of brick, stone or reinforced concrete.

Roof of approved non-combustible material, with all metal members protected with approved insulating material as required by the local building code for buildings of the first class. Roof covering of non-combustible material or approved composition.

Cornice non-inflammable.

Floors of approved non-combustible material.

Unprotected metal, none.

Ceilings open, plastered solid, or wire lath and plaster.

Partitions, of non-combustible material.

Elevators and hoists, in brick shaft securely cut off by standard fire doors at each floor.

Stairs of iron with iron treads; in buildings with combustible floors, enclosed in brick shaft securely cut off by standard fire doors at each floor.

Cut offs between brewery and malt house, brewery and stock house or malt house and stock house should be complete, by use of blank walls, where practicable, and standard fire doors at each opening. Mill house or elevator should also be cut off from remainder of plant.

Plant should have a single occupancy.

Location. Within easy access of the city fire department, with adequate water mains, hydrants and city fire department apparatus.

STANDARD SUGGESTIONS FOR ARRANGEMENT OF HAZARDS.

Lighting should be approved incandescent electric lights with no open lights permitted in malt mill room or ice machine room.

Heating and power should be steam, boiler to be located in a separate building securely cut off by standard fire doors.

Brewing by steam.

Varnishing and pitching. None to be carried on so as to expose the buildings; large vats which cannot be removed from buildings, may be shellacked by approved composition, free from benzine, without artificial light, other than approved incandescent electric lights. Pitching may be done in building, pitch heated by steam-jacketed kettle in fire proof room securely cut off where impracticable to do same outside.

Ice machine should be located in separate fire proof room securely cut off by standard fire doors.

Malt mill should be in separate fire proof room securely cut off by standard fire doors. If malt mill is in building and meal is not run directly into mash tubs or bags, an iron receiving hopper must be placed below the roller; malt mill box and screen box should be of iron; elevator for grain or meal to have iron legs.

Rollers of malt mill should be driven by cogwheel gearing, by independent belt for each roller, or by friction gearing with spring tension.

Magnet for eliminating metal particles should be above malt mill roller.

Cleaners; malt should be properly screened before passing through mill.

Hoppers for storing grain or meal should be constructed of iron.

Stock houses, where of entirely fireproof construction, should have fermenting tubs and other fixtures of metal.

Steam jets. Automatic steam jets should be provided in malt mill box and in legs of ground meal elevator. In lieu of automatic steam jets, approved automatic device for preventing dust explosions will be accepted.

Strut boards. All heads of elevators used for meal or grain should have slanting strut boards.

Kilns should be in brick, stone or concrete buildings securely cut off from malt house.

STANDARDS FOR PROTECTION.

Standpipes, with approved hose and outlets each floor.

Watchman's service, with approved clock and standard rounds.

Signaling system, of an approved type.

ALE BREWERIES.

In the main, the equipment of a modern American ale and porter brewery does not differ essentially from that of a lager beer brewery. The chip-cask cellar of the lager beer brewery, however, is dispensed with, a carbonating room taking its place, while the stock cellar is retained, since some of the ales are stored.

In one important respect, however, ale breweries are much less hazardous than lager beer breweries. Much of the ale is put up in bottles. That which is not bottled is put in kegs, which are coated with an enamel, a much less hazardous operation than keg pitching. The latter serious hazard is, therefore, removed.

Part II.

Historical.

The discovery of brewing has been ascribed to Gambrinus, the son of the German King Marcus, who lived 1730 B. C. The celebrated Egyptologist, Dr. Birch, says that the ancient beer called "hequa" is referred to as early as the fourth dynasty and was made from red barley or malt. Pliny wrote as follows: — "The several nations who inhabit the west of Europe have a liquor, with which they intoxicate themselves, which is made of corn and water." When the Romans conquered Britain, they found that a form of ale was being brewed in some parts, and greatly improved the methods then used.

Ale was the common drink of the Saxons before they invaded Britain, and no doubt they adopted the improved processes of manufacture which the Romans had taught to the Britons. By this time ale and beer were the general drink of the country, so much so that in the ninth century rents were sometimes paid in malt and ale. A difference in meaning between ale and beer is mentioned in Boorde's Dyetary, published in 1592, a quotation from which is as follows: — "Ale is the natural drink of Englishmen, and made of malt and water, while beer, which is composed of malt, hops and water, is the natural drink of the Dutchman, and of late, is much used in England, to the great detriment of many Englishmen." Hops gradually came into general use, but the word ale was retained, whether the liquor so designated contained hops or not. As early as 1585 there were 26 breweries in London with an output of 650,000 barrels per annum. It is interesting to note that New York City produces ten times that quantity, and the entire United States one hundred times that quantity, at the present time.

In Colonial times, as well as in the earlier days of our country's history, the consumption of malt liquors was relatively small and increased slowly. The wide distribution of small quantities of wine manufactured from grapes or currants, the introduction of tea, the general consumption of all classes of distilled spirits, and the household manufacture of cider and fruit brandies satisfied the tastes of the people, and the demand for malt liquors was of slow and gradual development. Where the demand existed at all it was for ale, porter or stout. The manufacture of lager beer in the United States was begun about 1840. It was extended with the general increase of population, the influx of German immigration, and the cultivation of the tastes of the people for milder beverages. In 1900 its use almost entirely superseded that of ale and porter.

MAGNITUDE OF THE BUSINESS.

In the proceedings of the fifty-fourth annual convention of the United States Brewers' Association, it was reported that 66,189,473 barrels of beer were made in this country in 1914, and 65,324,876 barrels in 1913. In 1912 beer was distributed through 12,123 wholesale dealers and 17,253 retail dealers in malt liquors.

In the thirteenth Census of the United States there were reported in 1909, 1414 breweries, employing 54,579 wage earners and about 11,000 clerks and salaried officers, superintendents and managers using material valued at over 96 million dollars, and turning out a product valued at $374,730,000. There was reported an invested capital of $671,158,110.

About 60 per cent of the establishments were distributed in the following half dozen localities, Pennsylvania 237, New York 184, Wisconsin 136, Illinois 106, Ohio 105 and the New England States 69. The malting industry is located principally in New York, Wisconsin and Illinois.

The volume of the business increased nearly seven times from 1869 to 1909, but the number of breweries operating has decreased about one-third. This probably means that the business has been greatly stabilized

by the elimination of many inefficient plants, operated by individuals in poor localities. That there has been a rapid tendency toward the development of larger corporations is shown by the following figures: — In 1899 47.4 per cent of all breweries operated as corporations, with 81 per cent of the total product. In 1904, the corporations operated 60.8 of all, with 88.2 per cent of the product and in 1909, 90.3 per cent of the breweries were operated by corporations which produced 90.3 per cent in value of all the output. There were 46 plants in 1904 having an annual product of over one million dollars, and 67 in 1909.

In 1909, there were reported 114 separate malting establishments, producing a product valued at 38 million dollars, with an invested capital of $60,286,113. There was a great increase in the malt industry from 1849 to 1859, due no doubt, to the rapid increase in the brewing of malt liquor at that time. The apparent decline in the industry from 1889 to 1899 is very marked and is probably due to an increased tendency of the brewers to make their own malt.

MORAL HAZARD.

The question of the moral hazard in breweries presents several interesting points of view. It is a curious anomaly that the quickening of the moral sense of the people of this country, if the great impetus that has recently been given the prohibition movement can be called such, may introduce a detrimental moral hazard, of vital concern to the fire insurance companies, doing a large business with breweries. The following significant paragraph is quoted from an article on "The Education and Future of the Brewmaster," which appeared in the October, 1914, issue of the Quarterly Journal issued by Hantke's Brewers' School and Laboratories. "There are a number of brewmasters in want of a position, and many more to whom betterment of their present situation would be very welcome. One of the main influences responsible for this situation is the fact that prohibition has done considerable harm to the brewing industry especially during the last two years. Prohibition has closed many breweries."

The present great European conflict has stopped the importation of German beer, but it is stated by the brewers that this seeming impetus to the home industry is much more than offset by the general business depression and decreased consumption of beer which is caused by this war.

During the past 20 years the population of this country has increased about 50 per cent, while the output of the breweries has increased 100 per cent. It is probable that the saturation point, so to speak, of per capita consumption has been reached and that there has been a tendency for the brewery to expand beyond the economic rate of supply and demand.

It is apparent, however, as seen by the previous statistics on the decrease in number of breweries, increase in product, and the decided increase in the per cent of corporations, that the financial stability of the brewing industry as a whole, has improved. Probably no large industry has a less percentage of impecunious adventurers and proprietors of small

means. Breweries are generally of superior construction and represent a large investment. The business, as a whole, has been a profitable one.

The location of a brewery, without reference to exposure and protection, is important. In general, the most successful breweries are located in cities or towns containing a sufficiently large population to make a good demand for their product. On the other hand, a brewery, if located in a section of the country where every material used in the manufacture of beer, and in the care of the same, during and after its manufacture, is imported into the locality, and when the beer has to be exported to a distance to effect a sale, may be a bad investment.

Part III.

Manufacturing Beer.

PLANT IN GENERAL.

Rarely, if ever, is a brewery confined to one building. The plant is often located in a section where ample ground may be had and the favorite arrangement of buildings under such conditions is in the form of a partial quadrangle with an open court in the centre or at one side. The brewing operations proper are carried out in three departments, so arranged and equipped as to allow of a separate gravity plan of transfer of materials in each. By this is meant that in each department the raw materials and beer are elevated but once to the highest point in the building, whence, in progress from one stage of manufacture to the next, they fall or flow from floor to floor by gravity. It is obvious that a vast saving in both power and labor will accrue from the continuity of operation obtained through this method of manufacture. It is claimed that for an equal yearly output the cost of operation in older plants of poor design or faulty arrangement is double that of the modern plant. This is an important point in judging the moral hazard. These departments consist of the elevator or mill house, the brew house, and the cellars or stock house. There will also be the boiler house, the power and refrigerating plant, the wash house, racking and bottling plant, coopering and pitching department and stables. A brewery may also have an ice house, a plant for the recovery and storage of spent grain and a bar fixture repair shop and storage room.

The three principal departments, including the power plant and boiler house, are mostly located in brick buildings, which from outside generally have the appearance of one building. They usually have steel frame and brick arch or tile and concrete floors, especially in the brew house and stock house, but these frequently have light joist roofs. The floors of the stock house and cellars are frequently cork filled with concrete covering. The remainder of the plant is generally of wood and inferior construction.

The various buildings communicate with each other, with more or less effective cut-offs. In some cases the openings will be found so numerous or so poorly provided with fire doors or blank walls, as to make the

entire plant practically one hazard. In a well designed brewery it is possible, however, to have the plant divided into several good fire sections and the hazardous portions, expecially the mill house, should be cut off in standard manner. Fire doors in refrigerator sections have been found to deterioriate rapidly and require regular and competent inspection.

It is particularly important that there be a complete cut off between coopershop, pitching department and repair shop.

A section of a typical brewery is shown by Fig. 1.

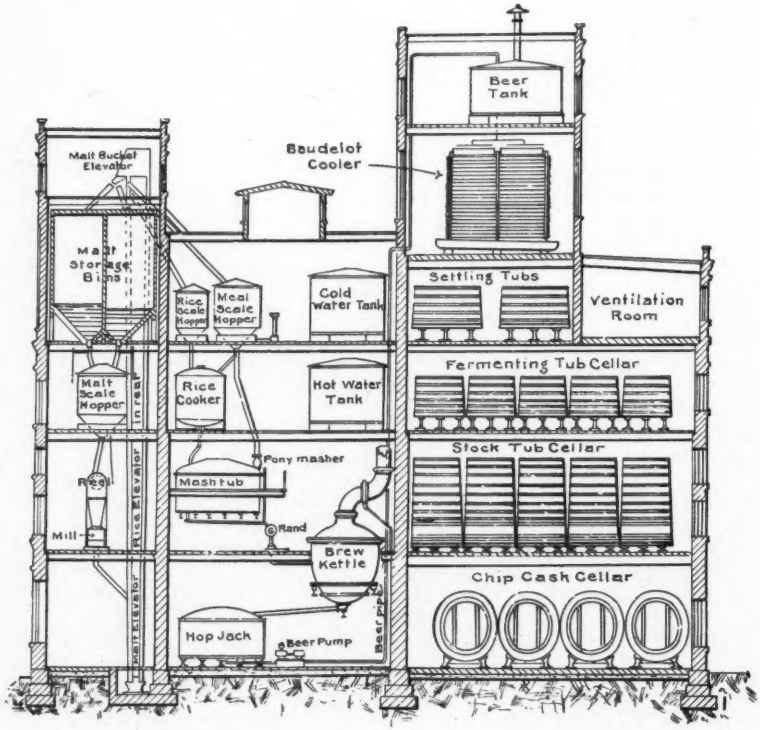


Fig. 1

Section of a typical brewery.

MATERIALS.

Malt.

The two essential chemical processes involved in the manufacture of beer are first, the conversion of starch by means of diastase into certain soluble substances, maltose and dextrin, the former being a fermentable sugar, and secondly the decomposition of this sugar by means of the yeast organism into alcohol and carbon dioxide gas.

Both of these conditions are satisfied in the case of certain germinating seeds and although many have at various times been tried, long experience has shown that germinated barley or malt, possesses in the fullest degree the various properties necessary for the brewing of beer. Dextrin is not so readily fermented in the cask, producing beneficial and pleasing results on the beer.

Substitutes.

In the best beers all the sugar contained in the sweet wort is derived from the malt of the mash, and consequently all the alcohol contained in the finished beer is thus derived. Beer production can be rendered more economical, however, if the sugar content of the sweet wort be increased by adding starch which will be converted into sugar by the excess of diastase present in the ground malt. By this means the amount of alcohol derived from a given weight of malt can be very largely increased for malt contains diastase in quantities sufficient to convert into maltose more starch than that which is stored up in the malt itself. Beer thus produced is said to be derived from substitutes.

Grits.

The substitutes commonly used are corn, in the form of grits, with the germ and husk more or less removed, and rice, either broken or as a meal, and generally prepared in a special rice cooker. These substitutes are always used in conjunction with a large proportion of malt.

Hops.

These are the female flowers (catkins) of Humulus Lupulus, consisting of cup shaped corollas with a round ovary containing one seed. A considerable number of these flowers, from 40 to 60, grow together in the form of cones which are technically known as strobiles consisting of numerous bracts. (See Fig. 2). At the base of the bracts will be found a yellowish powder known as lupulin, which is usually spoken of by brewers as "Condition." The percentage of this lupulin runs from 2 or 3 up to 16 per cent in new and rich hops and this percentage is a rough indication of the value of the hops. It contains the essential oil, resins, wax, bitters and a number of nitrogenous bodies including one or more alkaloids. Of these constituents the essential oil and the bitter substances impart their characteristic flavor to beer, while certain of the resins are markedly bactericidal and so confer on the hops their well known preservative properties.

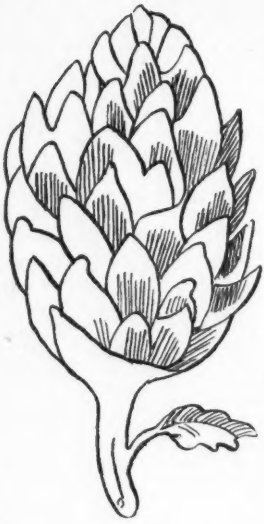


Fig 2

The Hop Flower

Hops require extreme care, if their bouquet is to be retained, and as a rule in breweries, they are kept in a special cold storage room. If these rooms are provided with electric lights there should be an outside pilot light on the same circuit. Hops are very susceptible to total loss by smoke or water.

PRODUCTS COMMON TO AMERICAN BREWERIES.

Most American lager beer is made by bottom fermentation, which is the German method, is rather low in alcohol, and contains a moderate amount of extract. Export lagers are made from stronger worts and contain more alcohol and extract. A special brew made in the spring from very concentrated wort and but little hops is called bock beer or Salvator beer. It contains much unfermented sugar and will not keep long.

Ale is a light-colored beer, often rather strong in alcohol and made by top fermentation with the use of a large amount of hops. This is also the English method of brewing.

Porter is a dark colored beer, containing much sugary matter and extract. For this, the malt is kiln dried at such a high temperature that it is partially charred, forming caramel which colors and flavors the beer.

Stout is similar to porter; but contains more alcohol and extract.

Ales and stouts that are stored for a long period are called "stock" beers. Those which are stored for only a short period, undergoing no secondary fermentation, are called "mild beers."

Processes and Hazards.

MILL HOUSE OPERATIONS.

Elevating. Whole malt is generally received in bags at the ground floor of the building. These bags are opened and the malt dumped into a hopper and elevator by an endless bucket conveyor and carried to the storage floor at the top of the building where it is spouted into bins or hoppers of wood or iron. The hazards here are those of the ordinary grain elevator, but in a less degree on account of the comparatively small amount of grain handled. Elevator construction and hazards are considered in a later paragraph.

Floor under bins will contain the malt and cereal scale hoppers of steel, round or square, provided with conical bottom.

Cleaning. From the scales the malt passes into a wire cloth power cleaning reel frequently built of wood with zinc screens. This cleaner should be placed in a separate room lighted by daylight if possible, and under no condition should open lights be allowed. The dust should be removed by fan with cyclone separator with vent outside. Malt used at some breweries is screened before being brought to plant and also again screened at plant, before being ground, as just described. Some screens are equipped with magnets and some are not. Where the screening machines are not equipped with magnets, probably more steel and iron chips, etc., pass over the grinding mill magnets than would if the screening machine were also equipped with magnets. The cleaned malt is passed to the malt mill.

Grinding. Grinding malt is effected by passing the malt through revolving steel rolls, two pairs being often used side by side, with the rolls set at different distances, the smaller grains being passed through one pair and the larger grains through the other. In this way, something approaching uniformity of grinding is obtained. The object of the brewer is not to grind as finely as possible, but to crush each grain thoroughly so as to permit of the ready attack of the starch by the diastase when water is added, and yet to bring about as little disintegration as possible of the husk of the grain which is needed to assist filtration in the mash tun. In certain modern processes of grinding the mealy portion of the grain is separated, after crushing by various mechanical devices, from the husk, and the former is then more finely ground, with the object of increasing the amount of extractive matter to be obtained from it. The rollers of malt mills should be driven by cog wheel gearing, by independent belt for each roller or by friction gearing with spring tension.

There should be magnets provided over which all the malt must pass on its way to the rolls. These magnets are for the purpose of removing all particles of iron or steel which may have passed the cleaner and which would damage the rolls or strike a spark in passing through. Some magnets are so arranged as to throw such particles of metal aside, while others hold the metal until it is removed by hand. Magnets should be carefully watched and replaced when they begin to show any weakness.

It has been conclusively proved that ground malt dust is of a more inflammable nature than wheat flour dust, hence the greater urgency that all foreign substances which might, by friction, emit sparks in the mill should be excluded from it, and there should be no open lights near the malt mill nor within the room. Explosions in these mills are liable to create sufficient back draft to carry burning dust to ducts and head of elevator legs and thence by conveyor to ground malt bins. Fires frequently break out due to explosions in malt mills in the vicinity of bins on the upper floors.

The malt mill should be constructed below the roller in a manner that will automatically bank the ground malt up under the rollers in a way that will have a tendency to smother a spark should one be produced, thus preventing explosions from the ignition of dust in the space under the rolls.

A simple arrangement frequently used consists of a hinged wood flapper hung below the rollers in such a manner that the ground grain accumulates against it until there is sufficient weight to force the flapper open, allowing a small amount of the meal to pass through the opening at a time. With this arrangement the accumulation of the meal below the rollers would have a tendency to smother a spark, should one be produced. If, on the other hand, an explosion occurs, the flappers promptly yielding to the slightest compression, provides a ready exit to the up elevator legs which are provided with automatic explosion vents through which the force of the explosion is quickly spent. It is needless to say that these elevator legs should be fireproof.

Another and more modern arrangement, is one in which the flappers, or butterfly valve, below the rollers are properly counterweighted or held in place by a spring. This is a better arrangement than the one just described inasmuch as the spring, while providing a ready means of venting the force of an explosion, also promptly pulls the flappers back into place, having a tendency to check the draught and smother any fire that might start. These two arrangements are installed in the so-called old style wood and glass mill.

As there is a possibility of fire in the mill resulting from explosion, the mill enclosure itself being inflammable, a steam jet should be inserted into all such mill enclosures, the valve controlling the steam supply being automatically opened by the burning of a string which is also inside of the mill enclosure.

Figure 3 shows sectional views of three malt mills in common use, showing the position of the magnets, the rollers, the banking arrangements and the location of steam jets, explosion vents, etc.

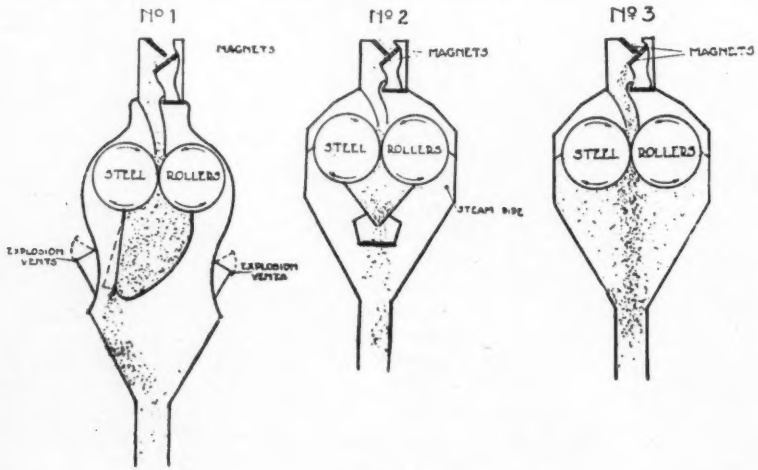


Fig. 3

1. Best type of mill. As this mill is entirely fireproof no steam jet is needed. Explosion vents are provided instead.
2. Wood or glass enclosed mill with wood flapper. Meal banking arrangement below rollers held in place by springs. Steam jet provided.
3. Wood and glass enclosed mill with magnet. Dangerous, because not provided with meal banking arrangement or steam jet. An explosion would result seriously.

Some well known mills are the Ferdinand Universal malt mill, Otts malt machine, Kestnor magnetic malt mill, the Schock non-explosive malt grinder, and the Simon Buhler & Baumann Universal Malt Mill. These are all well recommended.

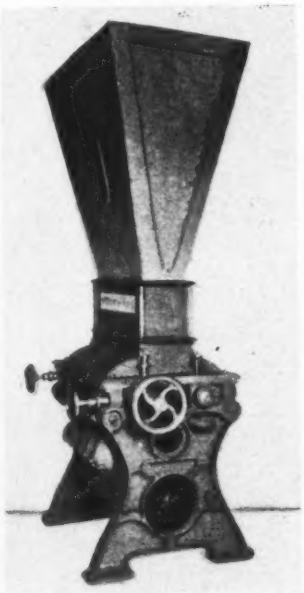


Fig. 4

The Schock Non-explosive mill, Fig. 4, is a finely arranged mill from the fire protection point of view. This mill is practically fireproof, the enclosure and the interior working parts being made of steel and heavy glass. The meal banking arrangement in this mill is especially good; not only is the ground meal retained in a receiver under the rollers, but it is kept there until the flapper is forced open by the pressure of the confined meal induced by the rollers themselves. It is estimated that the pressure necessary to open the relief flapper when the mill is in action is between 15 and 20 pounds. The S. B. & B. Universal malt mill is shown in Fig. 5. Particular care has been taken in constructing the explosion preventers under each set of rollers. They are constructed in such a way that an explosion is impossible while, on the other hand, the different products created under each crushing stage can easily be discharged. An explosion with their preventers is said to be an impossibility.

The prepared malt now passes to the basement or receiving hopper and is again carried to the top of the building by the same conveyor that elevated it in its original state; but this time, instead of going to the same storage bin as before, it is taken by another conveyor to the storage bins in the second department, having now both completed the first gravity stage and finished with the first department.

After the malt is ground care should be taken as to where it is deposited. It should never be placed in a room in the presence of an open light, and electric lamps should be of the double globe type. When barley is roasted, ground and left in a heap, there is said to be some risk of spontaneous

ignition. For this reason alone, therefore, the gradual substitution of iron hoppers for wooden ones is welcome, although the additional advantage that the former are less liable to extend a fire must not be overlooked.

Elevators.

The floors of the mill house are pierced by a number of small chutes and worm or chain elevator enclosures or legs through which the malt is conveyed as previously described. The elevator is a very frequent cause

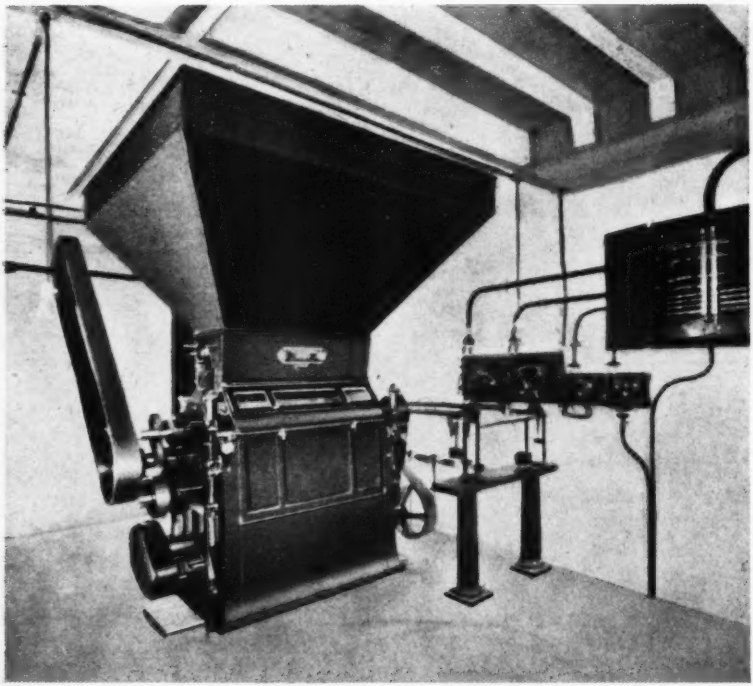


Fig. 5

Malt Mill

of fire, either in origin or transmission. The enclosures should always be in an upright or slanting position so as to render them self-cleaning and they should invariably be of fireproof material. The different parts of an elevator are known as head, legs, boot and strut-board, all of which are self explanatory, except the strut-board, which is a piece of wood, located immediately under the pulley in the head. It should be inclined so that any grain or dust which falls upon it, as the buckets pass over the pulley, will slide into the leg. When a horizontal strut-board is in use the grain

piles upon it, becomes soaked with oil from the pulley bearing and the heat generated by the revolving pulley often starts a fire. It will be readily seen that flat strut-boards should never be used on elevators conveying ground malt. In elevators having "friction heads" (one pulley operated by friction with another), fires are often caused by clogging.

Elevators used in conveying ground malt after it has passed through the mill should be provided with explosion vents (automatic self-closing traps), which, in the event of an explosion in the enclosure, act as a vent through which the force of the explosion is spent, thereby preventing serious damage to the elevator legs and the mill itself.

The non-fireproof elevator legs or enclosures beyond the mill should be provided with a steam jet opening into their interior, controlled by a valve held shut by a string which passes through the leg. With this arrangement, a fire in the elevator leg would burn the string which would automatically open the valve and flood the leg with steam, smothering the fire. A fire axe should be placed near the mill and at the head of the ground malt elevator. Chemical extinguishers or fire pails should be placed at each of these locations.

The archimedean screw or worm conveyor, which is sometimes used to carry the ground malt or grain from the mill, is a potent agent in rapidly extending a fire. It has been suggested that if the flanges of these were made of phosphor bronze instead of iron there would then be but little danger of sparks being caused in the worm by any metallic substance. As the screw revolves slowly, the bearing hazard is not great.

BREW HOUSE OPERATIONS.

Mashing.

From the ground malt bins the malt passes to a weighing machine and then to the process of mashing, in which the diastase of the starch of the malt or other grain (when this is used) is converted partly into fermentable sugar and partly into other substances which are either unfermentable or which only undergo fermentation with considerable difficulty. The resulting liquor is called wort.

There are three mashing systems distinguished by different methods of applying temperatures to a mash.

1. Infusion or water mash. English beers. High initial temperatures.
2. Decoction or thick mash. German lager beers. Low initial temperatures.
3. Malt infusion and unmalted cereal decoction mash. Amercan lager beers. Low initial temperatures.

In the process of mashing, the crushed malt has to be mixed with the requisite amount of water under such conditions of temperature that the action of the diastase on the starch can be kept within necessary limits. The vessel in which this action takes place is known as the mash tun. It consists essentially of a covered cylindrical vessel, constructed usually of

wood or iron, fitted with a perforated bronze strainer or false bottom, revolving rakes or stirring machinery, a sparging or washing appliance and a number of wort pipes for drawing off the resulting clear wort. A non-revolving shovel, located just above the false bottom, is used for throwing out the grain after the mash is finished and the wort or extract run off.

In some cases the admixture of crushed malt (grist) and water is made directly in the mash tun itself, but more frequently a mechanical appliance known as an external masher is used, by means of which a more perfect admixture of the malt and the water can be made, which enables the brewer to maintain a more exact control over the termperature of the mixture, which is a matter of the highest importance. The chemical reactions involved in the diastasic transformation of starch are of a highly complex character, and it will serve no useful purpose to attempt to deal with the various views which have been held by the many chemists who have devoted themselves to this subject.

It is worthy of note, however, that beer differs from many alcoholic beverages in that its flavour and character are quite as much, if not more, dependent on the nature of the unfermented extractive matter, than on the presence of alcohol and other volatile products of fermentation. In addition to this, it is essential that it should be capable of undergoing a certain amount of fermentation while in the cask (and often in the bottle) awaiting consumption. This cask fermentation keeps the beer charged with carbon-dioxide gas, and without it the liquid would speedily become flat and undrinkable. It is clear from these considerations that the extractive matters derived from the malt or other materials must not be completely fermentable, for if that were the case, the resulting liquid would be little more than a dilute solution of alcohol, and would not possess any of the characteristics of beer.

Since malt contains more diastase than is necessary for the conversion of its own starch, a proportion of starch derived from some other source may be used, the conversion taking place as in the case of the barley-malt starch itself. When, as is usually the case, some form of prepared grain such as flaked or gelatinized corn or rice is used, all that is necessary is to mix the grain uniformly with the malt in the mash tun itself and proceed exactly as if an all malt mash were being made.

Treatment of Grits.

In the manufacture of these flaked materials the grain is first submitted to a cleaning process and is then broken up by machinery into small pieces, in which form it is known as "grits." In the case of corn this is preceded by the removal of the germ, which contains the greater part of the oil, this being objectionable from the brewing point of view. The grits are then subjected to the action of steam, whereby they are thoroughly softened, after which they are converted into flakes by being passed between hot rollers, and finally dried. The main result of this steaming process is to break up the cell structures of the grain and to gelatinize the starch and so render it amenable to the action of diastase at the comparatively low temperature of the mash tun.

Rice Cookers.

Occasionally, however, grain which has not been subject to this cooking process is employed, as for example, corn or maize grits, broken rice, oatmeal and (rarely) barley. In that case the starch is not in a condition to be acted on by diastase under the ordinary mashing conditions and it becomes necessary to submit the raw grain in question to independent treatment in a separate vessel known as a converter or "rice cooker." In this vessel, the grain, mixed with a small proportion of pale or active malt is slowly heated with water to about 180 degrees F. by means of steam, and is kept at that temperature for a little while, after which it is raised nearly to boiling.

Some of these rice tanks are open with steam coils inside and are safe, but the more modern rice cookers are tanks of boiler iron with revolving machinery inside (but not stayed on braces like a steam boiler). Rice and grits being placed in the tank, a manhole is screwed down and live steam turned on, so that the pressure in the rice tank is about equal to boiler pressure, and as alcohol steams at 180 degrees and water at 212 degrees F., a certain quantity of alcohol in rice and corn grits will often raise pressure in tanks to above boiler pressure. The tank being made of light iron and not stayed, as a boiler would be, is not equal to the strain, and explodes. This was the cause of the wreck of a brewery which cost over $100,000, and killed several men.

All pressure rice cookers (and kettles with false or steam bottoms) should be equipped with a spring safety valve, a steam pressure gauge, a reducing valve and there should be a man on duty at all times.

Sparging.

The mashing having been completed, the bright wort is run off from the insoluble portion of the grain, being filtered through the false bottom of the mash tun, and hot water is sparged on the residual grain, so as to extract as completely as possible the whole of the soluble matter. This is done by means of a rosette or sprinkling device for spraying the water.

Spent Grain.

The spent grain left in the mash tun when sparging is finished contains a little starch, the amount depending on the thoroughness with which the malt has undergone modification during the malting process, and on the success with which the mashing operations have been carried out. It also contains the insoluble proteins of the malt, a little oil from the malt, and a good deal of digestible fibre. It has consequently a moderately high cattle feeding value and is readily purchased for that purpose by farmers and others.

Most frequently the spent grain is bought in the wet condition, with about 75 per cent of water, as soon as made, especially in summer, as the wet grain rapidly becomes sour and unpleasant. It is also subject to spontaneous ignition.

Grain Recovery.

In some breweries the spent grains are first dried, since in this condition they will keep good indefinitely. The recovery of the spent grain, however, has come to be an independent business and is not often carried on in the brewery itself. Where it is done, it considerably increases the hazard of the plant, and the reclaiming building should be entirely removed from other buildings of the plant and have as little woodwork about it as possible. Attendants should never leave dryers alone.

Many of the plants for the recovery of brewery refuse for cattle food have been badly damaged or destroyed by fire in the past few years, due largely to trouble with the drying apparatus. The Hooker system of grain drying used in a number of breweries consists of a high, steel tower about eight stories in height, through which hot air is drawn from boiler flues by a blower, and down which the wet grain is allowed to circulate after being elevated to the top of the tower by two ordinary chain and bucket elevators in steel and wood enclosed shafts. This system of drying does not invite trouble.

Brewing.

The wort and sparge water are conducted to the "copper," "beer kettle," or "brew-kettle," and boiled together for some time. This has several objects.

(a) It concentrates the wort, which, by the infusion process especially, is very dilute, and about one-fourth of the water must be evaporated.

(b) It destroys the diastase, peptase, and any other ferment which may be present, and thoroughly sterilizes the wort.

(c) It coagulates and precipitates most of the albuminous matter remaining in the wort.

(d) It affords an opportunity of adding the hops, which are boiled with the wort from one-half an hour to an hour, and the tannic acid of the hops coagulates an additional quantity of undesirable albumen, this coagulation aiding in clarifying the wort and causing it to "break."

(e) The wort assumes a darker shade, due to caramelization of the sugars.

The brew kettle is a copper vessel of pear shape, with a hood to carry off the vapors and a double bottom for a steam jacket. It is sometimes heated by steam coils, but if direct fire is used the hazard is directly comparable to that of a boiler and the same safeguards are required. The latter method, however, is practically extinct in this country. Fig. 6 shows the upper floor of a brew house, and the top of the kettle.

During the boiling the wort is kept in a state of vigorous ebullition. A wide bulging copper that allows freedom to the ebullition is better than a deep copper with almost perpendicular sides and which constricts the space for circulation. Any hindrance to circulation causes increase in temperature. The wort at the bottom loses solidity, becomes frothy,

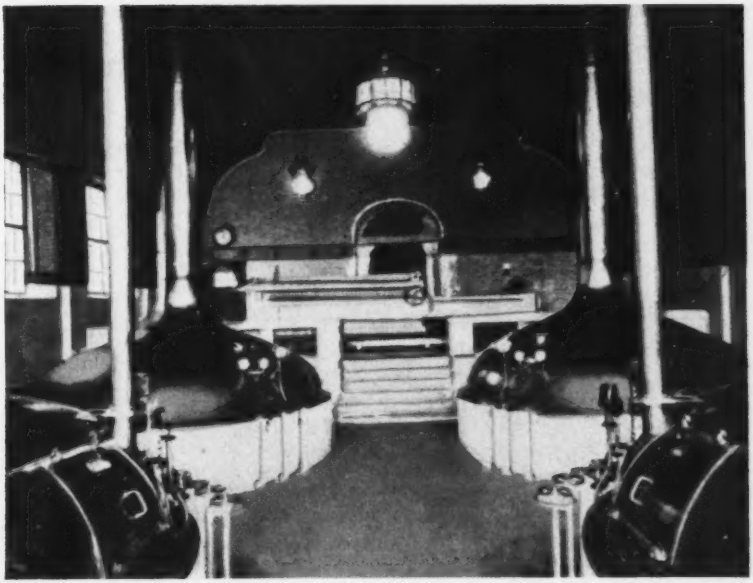


Fig. 6

Cookers and Brew Kettles

loses its conducting power, and the bottom of the copper is superheated. A wooden platform surrounding an over-heated copper has been known to ignite. The platform around the copper should always be of incombustible material.

A closed copper ought always to have a safety valve and lever to gauge and regulate pressure. Coppers in which the hops are upheld in perforated vessels are preferable, as otherwise the hops are liable to fall motionless to the bottom of the copper causing injury to it.

Straining. From the copper, the wort runs into the "hop jack" or "hop back," where it is allowed to stand for a period to permit the hops and albuminoids to settle. This is provided with a false bottom through which the wort is drained into a pump that delivers it to the cookers.

An incidental hazard in the brew house is the presence of sulphuric acid for cleaning the copper kettle.

This completes the second stage in the process. The wort now passes from the brew house to the top of the stock house or cellars.

STOCK HOUSE OPERATIONS.

Cooling.

The wort is now pumped through a sprayer into the surface cooler, a large, shallow iron pan, placed in a well ventilated room, where it receives

proper aeration and a premilinary cooling. At top of the stock house or cellars it is then sent over the Baudelot Cooler, or "beer fall," which is a pipe cooler in two sections, the upper one cooled by water, the lower one by brine or ammonia. The wort runs down over the outside surfaces of the pipes. Enclosed coolers have been taking the place of the former in many breweries of late. The wort circulates inside the pipes, and the water passes over the outside of the beer fall.

Fermenting.

From the cooler, the wort passes to a cellar below into tanks, where it is allowed to settle, and the clear liquid is then drawn into the fermentation butts or vats located in the fermentation cellars, usually the third floor of the stock house. These butts are made of oak, and are lined with pitch and asphaltum, or "brewers varnish". Fermenting vats are now frequently lined with a glass enamel, and some are being made of metal. They have a capacity of 50 to 100 barrels. The cellars are cooled to a constant temperature by means of circulating brine or by water, cooled to the temperature of fermentation, flowing through a coil of copper pipe placed in the vat about 2 feet below the surface of the beer.

A certain amount of pure yeast is added to each butt, the process being called "pitching"* and within a few hours the actual fermentation begins. According as the temperature of the wort is low or high, there is a "bottom" or a top "fermentation". The former is used for lager beers, and the latter for ale, porter and stout. A white froth appears on the surface of the liquid, and a large amount of carbon dioxide is generated, which escapes over the sides of the butt, and falling to the floor is usually carried away by an artificial draught. Methods have been devised to save this gas for use in refrigerating machines, and more particularly for carbonating the finished beer. The fermenting vats are covered, and the carbonic acid gas thus captured and compressed.

Tanking.

After some days the active fermentation ceases entirely, and the new beer is drawn into storage vats in the stock cellar. This is called "tanking the beer".

The time of storage varies from three to six months. During this period there is a slight secondary or after-fermentation under certain conditions and other developments take place, in flavour, etc.

These vats hold from 1,500 to 3,000 gallons and were formerly all made of oak lined with brewers' varnish. Recently, however, metal tanks, having an enamel lining are being used, and found to be very satisfactory. They are less expensive to maintain and a certain fire hazard is eliminated.

Clarifying and Fining.

When sufficiently matured in storage, the beer is run or pumped into the chip cask cellar, containing great oak casks in the bottom of which shavings of beech wood are placed. These aid in "clarifying" the beer and

*Not to be confused with the hazardous process of pitching kegs.

making it "brilliant". Chips must be carefully prepared by boiling in water with sodium carbonate. Isinglass is also used for "fining the beer" and is prepared on the cold or warm plan from fish sounds, or hide of the calf, containing gelatine as the active principle, its efficiency depending upon the amount of gelatinous substance the isinglass yields and which in flocculent form distributes through the beer enveloping the suspended particles and carrying them to the bottom. Finings are dissolved in stale beer, the beer being previously sterilized. Dilute sulphuric acid is sometimes used instead of stale beer.

Kraeusening.

To impart to the beer the necessary life, that is, a sufficient amount of carbonic acid gas so that it will foam properly when tapped, the process of "kraeusening and bunging" is carried out, or the beer is charged with carbonic acid gas directly. The former process consists in the addition of kraeusen beer, that is, young beer in the first, or kraeusen stage of fermentation. A few days after the kraeusen have been added the finings are introduced and the cask is bunged, to prevent the escape of the gas generated by the kraeusen, its accumulation causing a pressure which is termed bunging pressure and which is allowed to rise to about 5 pounds. A special apparatus is used at the bung, which will maintain a certain pressure on the surface of the beer, and release on over pressure.

Carbonic acid fermentation gas may be introduced into the beer at any stage after fermentation, but usually this is done while the beer is being transferred from the chip cask to the racking bench and before it reaches the filter. The gas is introduced either on the "pressure" principle by spraying the beer through a compressed atmosphere of gas or on the "aspirator" or "injector" principle, by forcing the gas into the beer, usually in a conduit while in motion.

Varnishing.

Wooden vessels in the brewery, like starting vats, fermenting vats, stock tubs, and chip casks, are varnished for the purpose of preventing any extractive matters that may remain in the wood from getting into the beer. At the same time the varnish prevents the beer from penetrating into the pores of the wood where it would sour and become a source of infection that would subsequently attack the beer run into the vessel. This work is usually done about once a year or once in two years and several hazards are thereby introduced.

It is first necessary to dry out the tubs and this was formerly done with charcoal braziers which were frequently upset, causing fires. This method is still in use but the modern and less hazardous method is to use a portable steam coil or an electric heater. With an electric beer-vat dryer a temperature of 100 degrees F., sufficient to dry a 50 barrel vat in 10 hours, can be obtained at a consumption of three kilowatts per hour.

It is sometimes necessary to first remove the old varnish. For this purpose the hazardous gasoline blow torch flame is frequently used. Some plants use a liquid varnish remover, which is also apt to be hazardous.

It has been found, however, that a brass brush and scraper will do this work effectively and without hazard.

The varnish or "brewers pitch" used for the purpose of coating the inside of the vats is a solution of shellac or specially prepared gums dissolved in either grain or wood alcohol properly rectified. Men have been overcome and suffocated in the vats, by the fumes, and fires have frequently occurred. A casualty from this process whereby an explosion and fire happened within a new cask during varnishing was recorded in this country as early as 1880. Open lights should never be used during this process and when electric lamps are used, they should be provided with vapor proof globes. It is also well to have a fresh air hose led into the vat during the process; which is done in some plants.

Filtering.

The process of filtering beer consists in forcing the beer on its way from the chip cask to racking apparatus, generally by means of air pressure applied at the chip cask, or through a pressure regulator pump interpolated between chip cask and filter, through one or more layers of compressed fibrous material, called filter mass, which commonly consists of wood pulp or paper pulp. Beer should always pass through the filter under back pressure, as it will otherwise foam to such an extent as to preclude the proper filling of the trade packages. It must be located in a cold place, usually in the chip cellar.

Pressure regulating pumps are used, which allow any desired pressure to be put on the beer passing through the filter on its way from chip cask to racking bench, thus reducing necessary pressure on beer in the chip cask and the strain caused thereby.

Racking off.

This is the name given to the process of filling kegs and bottles with beer. The so-called back-pressure racking system is now used. That is, a back pressure sufficiently high is created in the delivery package to prevent foaming of the beer, so as to permit of readily filling the package without loss of time and beer. The beer enters through a tube inserted through the bunghole of the package, fitting air tight, and permitting the filling of the package against counter pressure. Special automatic machines are used for filling bottles.

MISCELLANEOUS DEPARTMENTS.

Washing and Bottling.

The increasing demand for bottle beer in all parts of the United States has resulted in the establishment of separate bottling departments, very complete and efficient, and this has greatly reduced the hazard of a brewery, as in many instances, the use of kegs has been entirely abandoned, thus eliminating the pitching hazard.

The bottles are first placed in a soaking device (tank or machine), from which, when all labels, tinfoil, etc., are removed, they are run through

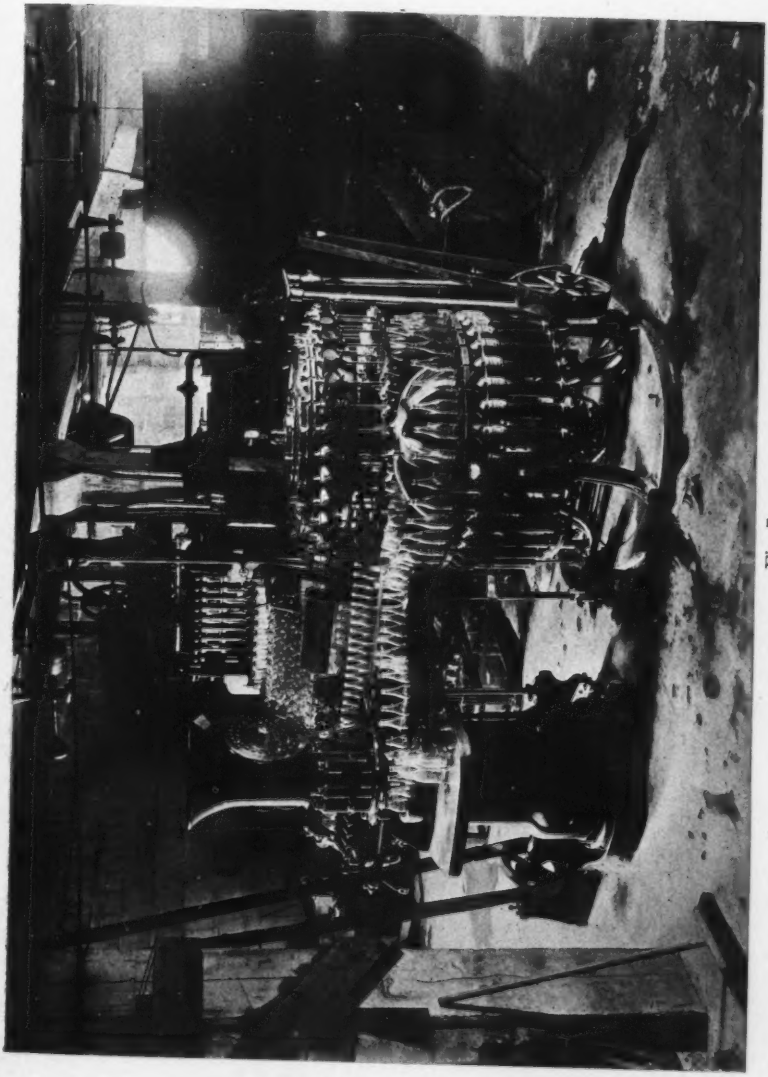


Fig. 7
One of many possible arrangements of machinery in the bottling unit. Washer in background and filler in foreground.

the washing machine, placed on the adjacent rack next to the filling machine, and closed either with cork, cap or patent stopper. They are then carefully examined, clamped or wired, and put in a crate previous to going into the pasteurizing tank. After being sterilized in a hot water bath, they are labeled and capped with tin foil. Fig. 7 shows a washing and filling department.

In large establishments the filling from barrels carted to the bottlery across the public highway—as required by law—has been generally replaced by filling from government tanks, connected by pipe line from the chip casks directly. Here the casks or tanks placed in a separate refrigerated room under the bottle shop, are filled and gauged under control of a government inspector.

Coopering.

A full coopering plant is only occasionally found, but in any event the plant will be found to re-cooper its own packages. The hazards of the work are those of a hand carpenter shop, except for the pitching which is frequently in the coopering department, and for this reason the work should be done entirely away from the main values. In many cases re-coopering will be done in an open shed, and the usual good housekeeping conditions, so typical of the average brewery, are lacking in this section. Stave billets piled in open yard should be kept away from buildings.

Pitching.

This has proved to be the most serious hazard in a brewery. Trade packages are internally covered with a coat of pitch for similar purposes to those which lead to varnishing storage casks, etc., i.e., to prevent the beer from coming in contact with the wood. Ordinary brewers' pitch, most commonly used, is the purified resin of certain coniferous trees, as pines and firs. The resulting colophony is softened or made pliable by melting with some rosin oil, cotton-seed oil or paraffin.

The process of pitching is sometimes found in a detached building and very rarely of fire resistive construction, but is usually located in the wash room or in the coopershop or adjacent thereto in some cheaply built shed, which heavily exposes the whole building. The old fashioned pitch kettles are generally of iron set over coal-fired brick super-heaters or furnaces, and insufficient care is frequently given to the matter of secure foundation and protection of surrounding floor and it is not unusual to find them located in pits. The flue pipe from the hood over the kettle may extend through the roof without having the surrounding woodwork sufficiently cut away or protected. Pitching sheds are frequently ingited by overflowing of pitch, or the ignition of vapors. It is obvious that pitch kettles should not be left alone when in use. Fires in pitching rooms, if built of wood, are apt to be flash fires due to the fact that woodwork in room has become saturated with pitch from pitch laden vapors that constantly arise in the process of pitching kegs.

Different systems are employed for introducing the pitch into the package, but first the latter is examined to see the condition of the old

pitch. One method is to bring the kegs to the wash house, fill them with cold water, and after standing ten hours they are emptied and filled with boiling hot water. When the hot water is cold it is emptied out. Kegs are then examined by dropping an electric light inside through the bunghole to see if there is any broken pitch. If the pitch appears in good condition, the keg is passed along as being all right. If pitch is not in good condition, it is usually removed by superheated steam or hot air and fresh pitch introduced. Sometimes a gas flame is used for this purpose. Fresh pitch is introduced either in measured quantity or by means of a spray, the surplus returning to the pitch kettle.

There have been several refinements of the process perfected to increase the efficiency and economy of the apparatus. One in particular is the Universal Pitching Machine. The apparatus is designed with considerable care, and the pitch is forced into the keg by heated compressed air under ten pounds pressure. The makers claim that the fire is fully fifteen inches from the fire door, and is so located that, should pitch be carelessly spilled over the outside of the brickwork of the pitch kettle, it would never reach the fire box. A separate pitch vapor pipe is attached to the pitch kettle to carry off the vapors so that same cannot come in contact with the heat of the smoke pipe. The pitch kettle has an iron cover and there is no apparent danger of setting fire to the inside of the pitch kettle. This type of machine is shown in Fig. 8.

Although this apparatus is a decided improvement on the old time pitch kettles, it is yet far from being satisfactory, as a coal fire is used, which is not desirable, in spite of the safeguards. We also have one record of a serious explosion of unknown origin which occurred in this machine, killing both the attendants, and no definite cause was ever assigned to the explosion.

The most modern way of lining packages with pitch, and the only type of apparatus recognized by the Underwriters' Laboratories, Inc., is a much safer method as the pitch is heated by superheated steam, and fire at the kettle is done away with. The packages are also more evenly coated and less pitch is wasted. This plant consists of a superheater in which steam at ordinary boiler pressure is superheated, an extractor which removes the old lining from the package by use of superheated steam, and a kettle in which the pitch is melted by the use of a superheated steam coil. Plant is equipped with a metal smoke escape. No power nor

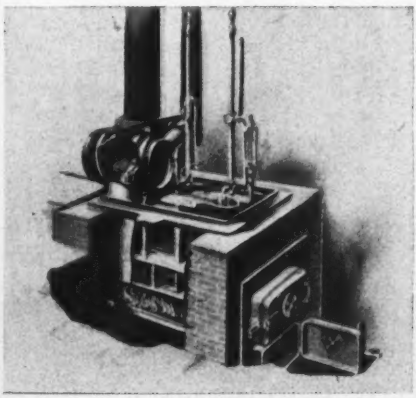


Fig. 8

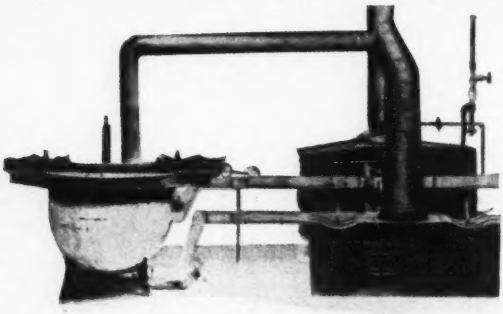


Fig. 9

brick work is required and the objectionable pit in the floor is eliminated. This type of pitching plant is shown in Fig. 9.

It is best, however, to have this plant located in a detached building. If located inside main buildings, it should be installed in a separate fire-proof room, well ventilated and with standard fire doors at all communicating openings. Only such machines as meet the approval of the Underwriters' Laboratories should be allowed.

The hazard of keg pitching is entirely lacking in ale breweries. Most of their goods are racked in bottles. Such kegs as are used have a small amount of alcohol-thinned enamel paint brushed over the inside before the heads are put on, and a torch applied. The inner surfaces of the keg burn for a moment while the solvent is being consumed, and the enamel hardens.

Branding.

Branding of packages is frequently done after they have been pitched. The branding machines may be heated by gas or gasoline. If the latter is used it should be removed a safe distance from the building, and the gasoline gas system should comply strictly with the rules of the National Board of Fire Underwriters. Electric branding irons are now coming into vogue.

Repair Shop.

Most breweries own or control many saloons through which their goods are sold, and they frequently maintain a bar fixture repair shop. The old bar fixtures are repaired by a carpenter who may use a glue pot heated over a kerosene stove. Repolishing is done by the use of linseed oil and rags with the hazards incident thereto.

Fixture Storage.

At the present time, owing to the economic conditions of the industry, as previously described, many breweries are called upon to store the bar fixtures of saloons which have gone out of existence. They are apt to be crowded into some place not originally designed for such storage, where the construction is not of the best, and a considerable fire risk may thereby be introduced.

Stables.

Most breweries do a large amount of local delivery and have a stable on the premises. The management is apt to be lax in this portion of the plant, and the stable should be examined with care. The amount and nature of hay storage should be noted.

Ice House.

A few breweries have regular storage ice houses. These should be well detached, and if any portion of plant is seriously exposed by same, protection against this exposure should be provided. No sawdust nor shavings should be used in lining of artificial refrigerator houses.

Power Plant.

The steam consumption in a brewery is large and the boiler room is a very important part of the plant. It should be well cut off from the rest of the plant. The large plants have automatic stokers and ash-removing systems. In brew houses live steam is required for cooking, hence a large portion of the total steam generated must be delivered at boiler pressure. The proper protection of steam pipes where passing through or near any inflammable construction or material is consequently a very important matter. Also the increasing use of copper pipes for conducting hot liquors necessitates the use of a large amount of jacketing. This may become a source of fire hazard from the materials used, such as rope, cut straw or shaving, and the wooden casings may aid materially to spread fire once kindled.

The machine room contains the steam engines, refrigerating machines, air compressors, dynamos or motor generators.

A rather recent engine room accident happened due to the failure of the fly wheel, which burst, wrecking the oil machine and ammonia condenser, damaged other machinery and crumpled up a ten foot section of a 10 inch steam header. About $3,000 worth of ammonia was lost, but lives were saved by the accidental escaping of steam from the header, which absorbed the ammonia gas.

Refrigerating Plant.

In the production of lager beers low cellar temperatures are quite necessary. The use of natural ice for this purpose is now seldom found, the refrigerating plant being quite generally used. The plant is generally of the direct expansion type and includes the compressor and piping with condenser and pan. The brine is cooled by the expansion of the ammonia gas, which again is compressed by the machine and the cycle is carried on indefinitely. Ice-making cans for a regular ice plant are a frequent adjunct. The Baudelot cooler, enclosed coolers, and attemperators in fermenting vats and chip casks may be called part of the system. The rooms to be cooled are the settling tank room, fermenting room, stock cellars, chip cask cellar, racking room, hop storage room and ice storage, unless a regular ice house is provided. The cooling agent consists of brine circulated through a system of pipes in the various rooms to be cooled.

In the engine room is usually found an ammonia tank with a gauge glass which shows the amount of ammonia in the tank. This is under heavy pressure and if the glass blows out there is an escape of ammonia into the room to such an extent that it is impossible to remain in the room.

All the gauge glasses and especially on the ammonia receiver and on the oil trap should be provided with automatic ball stops that shut off the gas if the gauge glass should break. Open lights should not be allowed near the compressor or oil trap, and electric lamps should be provided with vapor proof globes. The exhaust and suction pipes of compressors should be provided with either electrical or mechanical devices arranged to operate automatic check valves which will prevent the entire charge of ammonia gas escaping from the condenser and liquid receiver, as well as in the expansion coils and return lines, and, at the same time, automatically stop the engine or shut off the power should an accident occur at the compressor, or in any part of the piping.

Breweries offer the possibility of consequential loss, due to the crippling of the refrigerating plant, and this feature is of importance both from the manufacturing and the underwriting point of view.

ELECTRICAL HAZARDS.

Few industries have need for so many comparatively small amounts of power applied in widely separated departments as a brewery. In meeting these conditions electricity is being employed more and more as an ideal means of transmission. Of all the advantages of motor drive for breweries the three most important ones from the fire protection point of view are cleanliness, simplicity, and reliability. Cleanliness, if not voluntarily striven for by the brewery manager, is nevertheless compulsory in this age of stringent pure-food laws, and while the kind of machinery used has less to do with the cleanliness of the product than in any other industry, still the absence of grease, oil, dust, etc., which is characteristic of motor drive, is of some importance.

The use of electric lights in breweries is well established. Electricity is also replacing several old established manufacturing hazards by the use of electricity for heating glue pots and resin heaters, branding irons, and beer vat dryers.

It becomes of extreme importance therefore in view of the increasing use of electricity in breweries and the decrease in other hazards by virtue of this use, to see that this introduction of electricity is done in such a manner as not to substitute a serious electrical hazard in lieu of the others eliminated, which may more than counteract the good results contemplated.

In wiring breweries for electric light and power, many difficult problems present themselves. Moisture, ammonia and gases which prevail in breweries make it necessary to have the best and most lasting insulation for the wires. Open-knob wiring is best suited, as conduit, no matter how well painted and covered with asphaltum, will in time corrode. At the threads near junction and outlet boxes, which are the weakest parts of a conduit system, this corrosion is most active. The one piece tie knob is

often to be preferred here to split knobs, as the latter do not maintain as good insulation resistance as tie knobs. The moisture may work down the screw to the wire. Special blocks of wood well soaked with shellac or tar are first secured to the wall or ceiling and then on these the knobs are supported. This gives ample separation of the wires from the wall. A coat of asphaltum paint over the tops keeps out moisture and ammonia fumes. Ammonia attacks copper vigorously.

The location of fuses and switches is also important in breweries. These cannot be installed open on the walls because of the moisture, the ammonia and other corrosive vapors, and also because of the liability to mechanical injury. In this case again all metal cabinets have usually been found to be somewhat inferior to impregnated wood cabinets. These cabinets should be lined with heavy asbestos or other approved material set away from the wall and have a cover closing on a slant and provided with a small window. An ordinary eight-candle power lamp may be kept burning to keep the box dry and also to make it easy to find.

Porcelain, hard rubber or composition weather-proof keyless sockets may be used. Where porcelain sockets are employed they should be kept out of reach as they are easily broken. In the tank cellars, wash rooms and compressor rooms, the open-knob system, previously described, may have a slight preference. Where switch cabinets are not used waterproof switch enclosures should be used.

Wiring in a brewery should be regularly and carefully inspected, especially in the cold storage sections and the stable.

FIRE PROTECTION.

Breweries, very frequently, have but little fire protection equipment specially provided. This is perhaps accounted for by the three following features: — Superior construction, wet sections and presence of much hose and pumping systems about the brewery that could be used in emergency for fighting fires. The superior construction does not eliminate the special hazards and the desirability of chemical extinguishers being located in accessible places. There are, to be sure, certain constantly wet portions of plant where it is hardly conceivable that a fire could originate, but these do not render the plant as a whole, immune to a destructive fire. The large amount of rubber hose formerly so essential in all breweries for conducting water, wort and beer, is being rapidly displaced with the more general use of copper pipes, which has eliminated the expense of replacing hose worn out by the constant use and dragging about. Regular standpipes, with fire hose equipment, should be provided. There are, however, several pumps in a brewery, some of which at little expense could be connected with a standpipe system, and such an arrangement might prove very desirable, especially if there were no available waterworks, or a poor system with low pressure.

Automatic Sprinklers in Breweries.

There are very few breweries in the country that have been equipped with an automatic sprinkler system. This has probably been due to the

fact that the average brewery is of superior construction. In the few cases, however, that we have on record, where fires occurred in sprinklered breweries, the action of the sprinklers has been eminently satisfactory and amply demonstrated the desirability of such an equipment.

Although it does not appear necessary to equip the cellars with sprinklers, it is the opinion of the writer that most of the remaining parts of plant could well be equipped. It becomes of vital importance when certain important adjuncts of the business are carried on in attached frame portions, such as the wash house, bottling department, coopering and pitching, etc.

The following is given as a most interesting case of successful sprinkler control in the face of the worst brewery hazard.

Fire occured in a wash house which contained two pitching machines in operation. The room was equipped with 215 sprinklers on a dry system, supplied by two dry valves which also supplied sprinklers in other portions of plant. Fire was caused by the explosion of a pitch kettle due to water falling into the hot pitch and spread with great rapidity over ceiling and other woodwork thickly coated with pitch from fumes rising from machines. There were 81 sprinklers which operated, and workmen who witnessed the fire stated that the sprinklers had the fire under control before a hose stream could be applied with the exception of a few small blazes here and there, which were extinguished by hose streams from private hydrants. The loss was only $480.

Watchman's Service.

Regular watchman's service should be maintained. An approved portable clock is recommended owing to the difficulty experienced in keeping wires in good condition in certain portions of the plant. Special attention should be paid to the layout of the watchman's stations to insure the thorough inspection of the entire plant. The numerous communications frequently found in breweries make it particularly easy for the watchman to invent short cuts, which at some time might prove disastrous to the welfare of the plant. The watchman should be provided with means of shutting off the flow of ammonia in case of necessity. It would be better to have at all times a man on duty in the engine room, as the paralyzing effect of the ammonia fumes on men is well known and offers a serious hindrance to fire fighting.

Part IV.

Manufacturing Malt.

The process of malting may be said briefly to consist in artificially inducing the germination of grain, chiefly barley, and when sufficient growth has taken place, in stopping it by the application of heat. During the germination or sprouting, two ferments, diastase and peptase are formed, while the cell walls enclosing the starch are softened and disintegrated so that the interior of the kernel becomes "mealy", thus facilitating the transformation of the starch into sugar in the process of fermentation or mashing described under the head of brewing. The production of diastase is the chief aim of the maltster. The amount is estimated by the

length of the sprout or acrospire, and is greatest when this has extended about three-fourths of the length of the grain. The chemical and physiological changes occurring during the conversion of barley into malt are highly complex, only partly understood, and need not be considered in this article.

Cleaning.

Barley is stored in bins in the store house, or elevator, from which it is loaded on a conveyor and carried automatically to the cleaning machine. Here the dust, dirt, dead and broken kernels, and foreign seeds are removed by careful sieving in revolving sieves, the dust and chaff being blown away by a strong blast of air. The refuse is frequently collected and sold to feed dealers.

Steeping.

From the cleaning machine the barley drops into the separator underneath. The different grades, two or three in number, are passed to the automatic scales, from which screw conveyors or some other device carries the barley to the steeping tanks.

These may be wood-lined tanks or cemented cisterns. The grain is "steeped" by soaking it for two or three days in water kept at a definite temperature. It is stirred frequently. The water is changed several times, as it becomes discolored with the soluble matter, oil, etc., which it extracts. The dead kernels and skimmings are floated off or skimmed off with a ladle. They are transferred to a separate bin or trough, and are dried and sold for feed.

Thus far the barley has been prepared for the actual process of malting, which consists in "germination" and "kilning". There are two general methods of malting: the old style floor malting, and pneumatic malting. There are several systems of carrying on the latter method, the principal ones being the Galland-Henning Drum System, the Saladin System and the Tilden System.

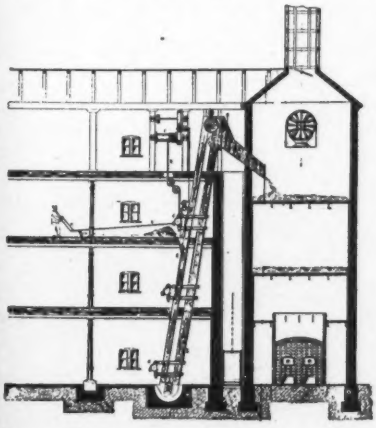


Fig. 10

Floor malting with Power Shovel and Bucket Elevator

Floor Malting.

The grain being fully steeped, the water is drained off at the bottom and the barley either dropped, loaded on trucks and wheeled or spouted to the malting or germinating floors, where the grain is couched by piling in a nicely leveled heap or "couch", one to two feet in height. Here it is turned over at intervals by wooden shovels and its height gradually increased

and again reduced according to conditions. After a few hours the temperature begins to rise within the couch and germination begins. The grain is then "floored" by spreading it with wooden shovels on the floor, in an even layer 10 inches deep. It is turned over every few hours to prevent its heating too rapidly and each succeeding day the layer is spread thinner, until it is finally only 4 inches deep. The acrospire reaches the desired length in from 6 to 12 days and the growth is stopped by spreading the grain in thinner layers. The floors of the malt house are usually of concrete or cement-faced brick arch; the room is usually only moderately lighted, and the building presents a vault like appearance. The air is kept moist by frequently sprinkling the grain and floor with water. A good circulation of air is a prime essential, and the temperature is maintained at from 50 to 60 degrees F.

Fig. 10 shows a section of a floor-malting plant with power shovel and bucket elevator, with the kiln at the end.

Pneumatic Malting. *Galland-Henning Drum System.* This process (see Fig. 11) consists in placing the softened grain in a rotating drum, containing along its inner circumference several channels, (A. A), covered with wire gauze and opening into the chamber (C) at the end of the drum. A tube (B) of wire gauze extends along the centre of the drum and connects with an outlet pipe (E). Into the chamber (C) a pipe (D) opens, which contains a valve that makes connection with the flue (F), or with the pipe (G), as desired. Air is drawn through coke towers, kept at a constant

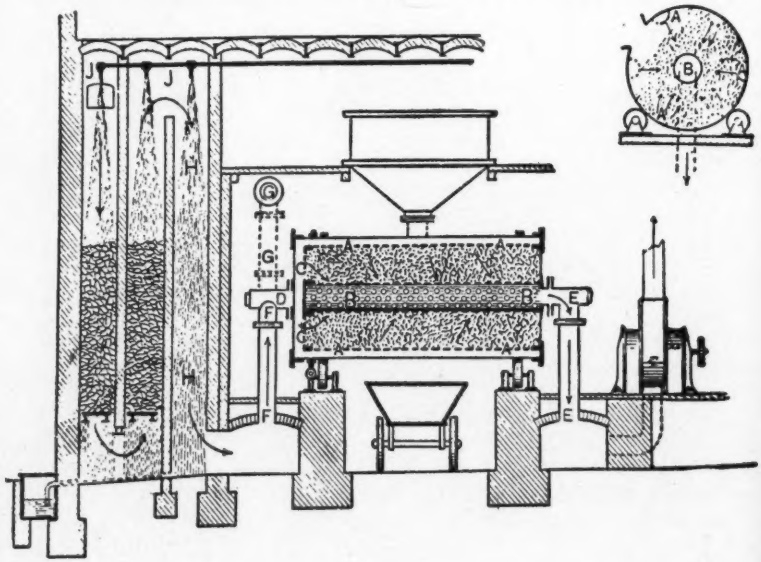


Fig. 11

temperature of about 57 degrees F., and through which water trickles. The air then passes down the flue (H), where it is in contact with a fine spray of water escaping under pressure from the supply pipe (J). It is thus cooled, or warmed, as necessary to the constant temperature of 57 degrees F. and, laden with moisture, passes through (F) and (D) into the chamber (C), and thence into the drum, through the channels (A, A). The drum is filled about two-thirds full with the swollen grain, and as it rotates about once in 40 to 50 minutes, there is a slow turning over of the whole mass of the grain. The air, entering through (A, A), passes through the mass, and enters the inner tube (B), from which it passes to (E), and thence to the exhauster, which drives it out of the building. Thus the grain is kept at a constant temperature in a moist atmosphere with a very effective circulation of air, and a constant change of surface of the kernels, which prevents undue heating. The grain sprouts as on the malting floor, but there is no handling and consequent breaking and crushing of the kernel, and no opportunity for the development of mould; since the air is filtered, very few germs are introduced. When the germination has gone as far as is desired, the valve in (D) is changed to cut off the moist air, and connection is made with (G), from which warm, dry air is drawn into the drum rapidly drying the acrospire and rootlet. The drums hold from one-half to five tons of barley at a charge, and the time necessary for the process is about 8 days.

Saladin Automatic Pneumatic System. The barley being steeped in the usual way is sprouted in the germinating compartments. The side walls of these compartments are built of brick or tile, laid in cement, the genermination floors are made of perforated metal in sections, which are removable, and are supported on legs, the space below the perforated floor forming foul air tunnels. Upon the perforated floors the steeped barley is spread to a thickness of about 24 inches and there remains until germination is complete. The barley is turned by automatic corkscrew devices which, rotating slowly, turn the barley, the automatic carriage moving slowly from end to end of the compartments. Air is drawn from outside by large exhaust fans located on top or in roof space of the malt house, is admitted to air tunnels at sides of the building, passed through coils and attemperated spraying rooms, through perforated sheets of metal, is attemperated, moistened, dried and admitted to the malt house germinating floors, is then drawn down through the growing malt to the foul air tunnels under the perforated floors and is finally exhausted through foul air ducts by fans to outside of building.

The Tilden System is the same as the Galland-Henning System, except that the air is admitted to centre of drum, is drawn through the growing malt and into the malt house through perforated sides of drums and the foul air is drawn from malt house by exhaust fan on top floor of building.

DRYING OR KILNING.

The dry room or malt kiln usually has two or three floors of wire gauze or perforated iron plates. The "green malt" is removed to the elevator leg; raised to top of tower and spouted on to the upper floor of the kiln where it meets with hot air drawn through and over hard pea coal fires and steam coils, up through the perforated floors and malt, by large exhaust fans placed in the top of kiln house.

Fig. 12 shows a kiln firing room, with kiln furnaces, malt hoppers and conveyor. In order to equally diffuse the heated air, a large plate, generally made of iron, and covered over with bricks or some other non-conducting material, is placed over the fire. Openings are provided in the walls of the room under the drying floor; by the opening and closing of these, together with the manipulation of the fire, the temperature of the air passing through the green malt is regulated. The air in the drying room may be heated by fire gases passing through pipes under the gratings. In the former method the products of combustion pass through the malt, imparting a darker color and a peculiar taste to it and to the beer made from it. The temperature on upper floor is kept at about 90 degrees F.

After about twenty-four hours, the malt is dumped on the lower floor where it is kept for about twelve hours at 120-130 degrees F. Fig. 13 shows the lower drying floor in kiln, showing malt dumped from floor above and before it has been turned by machine which travels over the

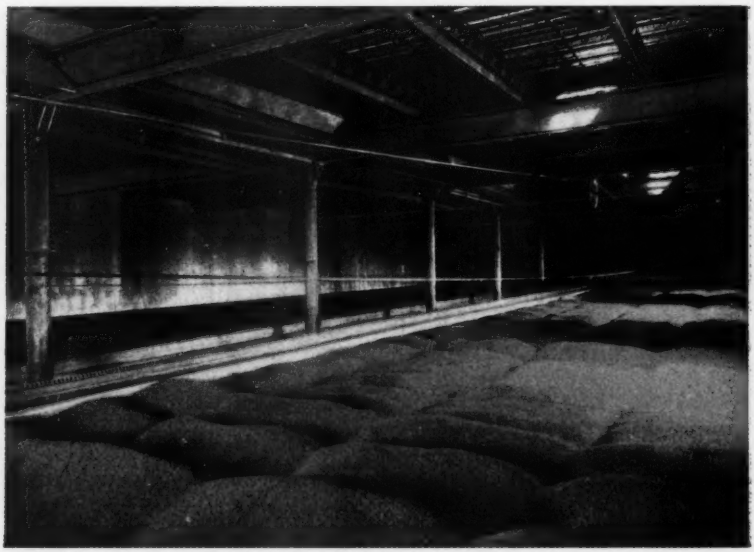


Fig. 13

Lower drying floor in kiln, showing malt dumped from floor above and before machine has turned it

floor for that purpose. A cog track and belt for drawing the arrangement for turning the malt, may be seen. It is practically dry, when it is heated to the final temperature of 150-166 degrees F., for pale beers, 168-180 degrees for darker beer and up to 220 degrees F. for beers of Munich character. It is thus apparent that the character and color of beers are much influenced by the mode of drying the malt.

The malt is now returned to malt elevator by conveyor run through malt screens or cleaners consisting of cylindrical sieves containing rotary brushes which remove the dried sprouts, and is placed on bins until wanted for use.

The production of a malt uniform in its properties throughout by the above method is very difficult, while different lots are sure to vary a good deal according to the temperature and humidity of the air. Consequently, at certain seasons of the year, it was customary to suspend operations. Penumatic malting remedies the above difficulties, prevents mould and acidity, is easily controlled, and requires less labor and less floor space, hence various forms of this system are replacing the old system in many large malt houses.

Fig. 12

Kiln firing room, showing kiln furnaces, malt hoppers and conveyor

HAZARDS.

The hazards in a malt elevator are about equal to those of a grain elevator, and the same precautions should be taken as regards elevator boots and legs, and the care of bearings. The dust is equally explosive and must be guarded against. Fires in fan rooms of malt houses have been the most frequent cause of fires and large losses. These rooms should be well designed, of fire resistive construction. The dust from the barley cleaning machine should be blown out of doors. No open lights should be allowed in the dry house. Fresh malt is thought to be susceptible to spontaneous ignition and should be stored in bins of non-combustible construction.

Malt kiln houses are usually separated from the malt house by a brick dividing wall. Any opening between should be well protected by standard fire doors. The old fashioned kiln with its tunnel stoke hole and hot air chamber behind, the floor of the latter being covered with three or four inches of malt dust, and chaff, is gradually being superseded, in large malting houses, by the modern big kiln with two or more furnaces and a central hot air shaft, the building being constructed of fire resistive material and detached from balance of plant. The old type of kilns is built with joisted ash floors and drying floors on wooden supports. One will generally find the risk of hot coals being raked back into the dust chamber, the desirable brick fender being absent. Such old fashioned malting plants are out of date and can only be run in cold weather. The moral hazard of such is doubtless considerable.

Part V.

Analysis of Fire Record.

On December 1, 1914, the National Fire Protection Association had a record of 149 brewery and malt house fires, of which 105, or about 70½ per cent, were due to some reported known cause.

There were 2 fires of incendiary origin reported and 6 fires caused by exposure, or 4 per cent. Of the remaining 97 fires, 51 or 52½ per cent were due to common causes and 46, or 47½ per cent to manufacturing hazards which were responsible for about 44 per cent of all known causes.

The common causes showed 10 cases, or 20 per cent of their number due to the carelessness and negligence of workmen, not directly attributable to regular common causes, such as light, power, etc. There were 8 cases, or 15½ per cent, due respectively to lightning and locomotive sparks, while 6 fires were due to smoking and the use of matches, or a little less than 12 per cent of the total. The remaining common hazards consisted of the following number: Spontaneous ignition 4, boiler 3, miscellaneous sparks, 3, heating 2, mischievous children 2, lightning 2, power 1, and Fourth of July, one.

A study of the conditions surrounding the fires the causes of which were reported as unknown, leads one to believe that careless or surrepti-

tious smoking caused a large number, and that several were probably due to spontaneous ignition.

The fires due to manufacturing, or special hazards, showed 17 of their number, or 37 per cent, due to the hazards incident to barrel pitching, and 10 cases, or about 22 per cent, caused by sparks and explosions originating in the malt grinding mills. There were 13 fires, or about 28 per cent which originated in the malt house, due to malt drying, spontaneous ignition of malt dust or bags, and friction in elevator legs or bearings of fan dryers. The remaining special hazard fires consisted of the following number: drying of spent mash (grain drying) 2, spontaneous ignition in ice house 2, one case due to vat varnishing and one case due to refrigerating system.

In considering the total known fires, it appears that nearly half of these were due to the following four causes, namely: the hazard of barrel pitching, over 16 per cent, the hazards of the malt house 12½ per cent, the process of malt grinding 9½ per cent, and the carelessness of workmen 9½ per cent. Of the latter, the following examples are worthy of note.

Workmen engaged in making repairs to elevator started fire with gasoline soldering torch.

Men were thawing out frozen pipes at water tank by using lighted candles. A candle was allowed to burn away, setting fire to rafters.

Employee repairing tin work in tower left his blow torch burning when he went to dinner.

Caused by plumber repairing pipes.

Tinsmith, who was putting on tin roof, was using soldering outfit and allowed soldering iron to remain in contact with wood long enough to start a blaze.

Plumbers, while installing new piping, allowed their torch to blaze too high, so that dry hops and the wood boxing of a pipe duct were ignited.

Painters disarranged electric light wires on roof.

LOSS RECORD.

The chronicle Fire Tables, during 19 years previous to 1902, report 926 brewery fires, or an average burning of about 49 annually. During this period there was an aggregate loss of $10,829,068, an average loss of $11,614, an aggregate insurance loss of $7,280,755, and an average insurance loss of $7,863.

During this same period there were 211 fires in malt houses, or an average burning of about 11 annually. During this period there was an aggregate loss of $3,950,448, an average loss of $18,725, an aggregate insurance loss of $3,381,233, and an average loss of $16,025.

The records of the National Fire Protection Association show 149 brewery fires, the losses being reported in 132 cases. Of these, 9 resulted in no claim, 15 in a slight loss, 38 in a small loss, 31 a moderate loss, and in 39 cases the loss was large. The average loss for 28 fires where the exact amount was reported, was about $9,000. This figure may be an approximate average, for although several fires were reported as having no loss, or a small loss, a few others were reported as heavy or total.

In some statistics gathered from another source on brewery fire losses during a ten-year period, it was shown that the average loss per fire was 7 per cent of the total value.

The record of losses in brewery fires seems to indicate that, as a class, the prevailing type of construction and the nature of hazards were such as to result in much lower losses than usually prevail in classes that are largely unsprinklered.

MISCELLANEOUS STATISTICS.

About 54 per cent of 140 brewery fires, with data given, occurred at night, while only 41 per cent of all fires for all classes recorded in the records of the N. F. P. A. occurred at night. This is explained by the fact that many breweries are in operation during the night. The statistics also show that nearly half of the manufacturing hazard fires occurred at night, while in a class, such as cotton mills, which rarely operates at night, only 10 per cent of the special hazard fires occurred during that period. And further, nearly three-fourths of the special hazard fires occurred while breweries were in operation, while 56 per cent of all brewery fires occurred while plants were in operation. The percentage of fires discovered by employees was also 56 per cent, in exact agreement with the total number of fires occurring while breweries were in operation. Of the fires occurring while breweries were not in operations, about half were discovered by watchmen and the remainder by outsiders. The watchman clearly failed to justify the service in 11 cases, which was about 20 per cent of the fires that occurred in plants where watchman's service was maintained.

Public outside equipment was used in a large percentage of the fires. Private outside equipment was used in quite a number of cases. The use of inside equipment appeared to be about equally divided between standpipes and water pails, while chemical extinguishers were reported as used in a small percentage of fires only.

There were only five recorded fires where automatic sprinklers were in use. In four of these cases the sprinklers practically or completely extinguished the fire, and in one other case fire was extinguished before sprinklers operated.

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THE ORIGINAL AND SUBSEQUENT REPORTS ON NEARBY 50 NEW ENGLAND BREWERIES in the files of the Underwriters' Bureau of New England, half of which breweries at one time or another, have been visited and inspected by the writer.

Department of Fire Record.

Most of the issues of the QUARTERLY have contained a fire record of some particular class of property together with a table setting forth the efficiency of the automatic sprinkler. The data given in these tables has been very helpful in proving the value of the automatic sprinkler and also in comparing the efficiency of the different sources of water supplies, pressures, etc. Unfortunately the number of fires in any one record has not been large enough to justify too much stress being placed on the conclusions to be derived from its study. There are many more-or-less accepted principles in regard to automatic sprinklers which to the best of our knowledge have never been proven by any reliable statistics. The tables given in the following pages have been worked up with the idea of furnishing reliable information on the action of automatic sprinklers in a large number of fires in order that a careful analysis of the results may be warranted on the assumption that the number of fires involved is sufficient to eliminate the possibility of distorted results due to a few fires under special conditions. This table, which contains 5782 fires, is the result of combining all the tables used in previous fire records and therefore covers a wide variety of properties as well as a period of several years. The various explanations and charts which follow are not an attempt to prove any particular theory in regard to automatic sprinklers but merely to assist in the study of the facts which this data seems to bring out. Whether or not the conclusions to be drawn from this analysis are in keeping with general opinion on the subject does not enter into this article.

Efficiency of Water Supplies

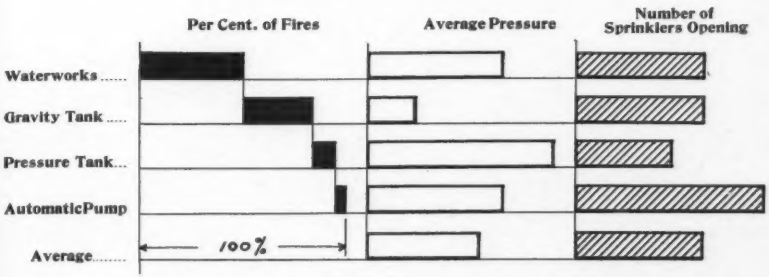

Chart 1

Primary Water Supply	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened
Water works,	2961	51.2	66	7.42
Gravity tank,	1938	33.5	24	7.40
Pressure tank,	627	10.9	91	5.72
Automatic pump,	256	4.4	66	11.06
Total or Average	5782	100.0	54.6	7.39

Primary Water Supplies. This first analysis is intended to bring out the efficiency of the various primary water supplies. The four sources of supply in the order of the frequency with which they are found are waterworks, gravity tank, pressure tank and automatic pump. A glance at chart 1 shows that the automatic pump was comparatively seldom found, while the waterworks was the source of supply in a little over one-half of the systems. A further study of chart 1 will show the relative water pressures found in these classes. The decidedly higher average for pressure tanks should be noted and kept in mind when some of the other data is considered. Chart 1 also shows the average number of heads operating for each system, and here we find a much better value for the pressure tank than for the others, while the automatic pump is decidedly the poorest of the four. This fact seems to emphasize the necessity of giving a system depending on an automatic pump a more liberal water supply than is customary for the others.

Efficiency of Water Supplies

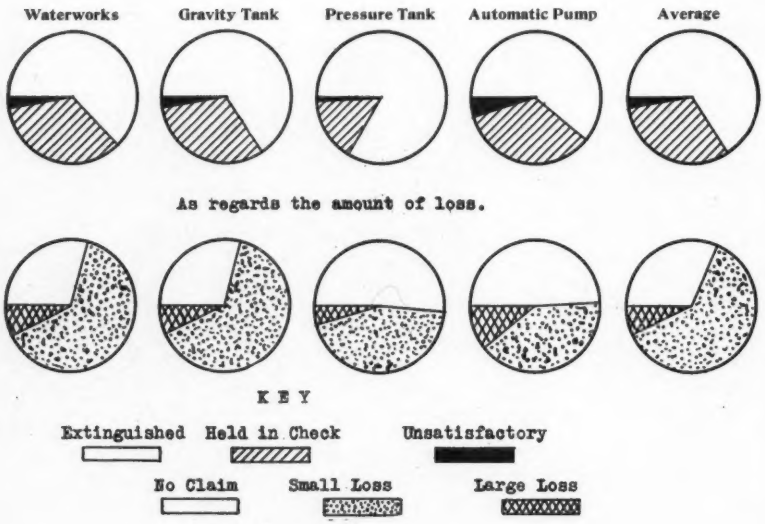

Chart 2

Primary Water Supply	Per Cent. of Fires			Per Cent. of Fires		
	Extinguished fire (or practically extinguished)	Held Fire in check	Unsatisfactory	No claim	Small loss	Large loss
Water works,	62.6	34.0	3.4	27.6	65.2	7.2
Gravity tank,	65.0	31.1	3.9	31.1	62.4	6.5
Pressure tank,	82.5	15.6	1.9	52.0	42.7	5.3
Automatic pump,	64.1	30.8	5.1	48.4	40.7	10.9
Average	65.7	30.9	3.4	32.3	60.8	6.9

This chart is intended to furnish direct comparison of the different sources of water supply with respect to their efficiency in the control of fires and prevention of loss. There seems to be two important points brought out in respect to the control of fires: (1) the pressure tank has a decidedly higher percentage of extinguished fires and the lowest value for unsatisfactory fires; (2) the automatic pump has had by far the largest percentage of unsatisfactory fires. There are several conditions which bring about unsatisfactory results from sprinklers in case of fire, among which the proper maintenance of the system is probably the most important. This chart would seem, therefore, to indicate the greater probability of a supply from an automatic pump being out of order. The reasons for the superior showing of the pressure tank are probably due to several factors, one of which may be the higher average pressure.

The lower half of the chart brings out practically the same points, when we consider the four sources of water supply, in reference to the amount of loss. A little more than half of the pressure tank fires have resulted in no claim for loss, while the probability of a large loss with this kind of water supply is only seventy-five percent as great as for the average of all water supplies. The probability for a large loss with an automatic pump is over twice as great as with a pressure tank and fully one and one-half times as great as the average for all sources of supply.

Efficiency of Water Supplies

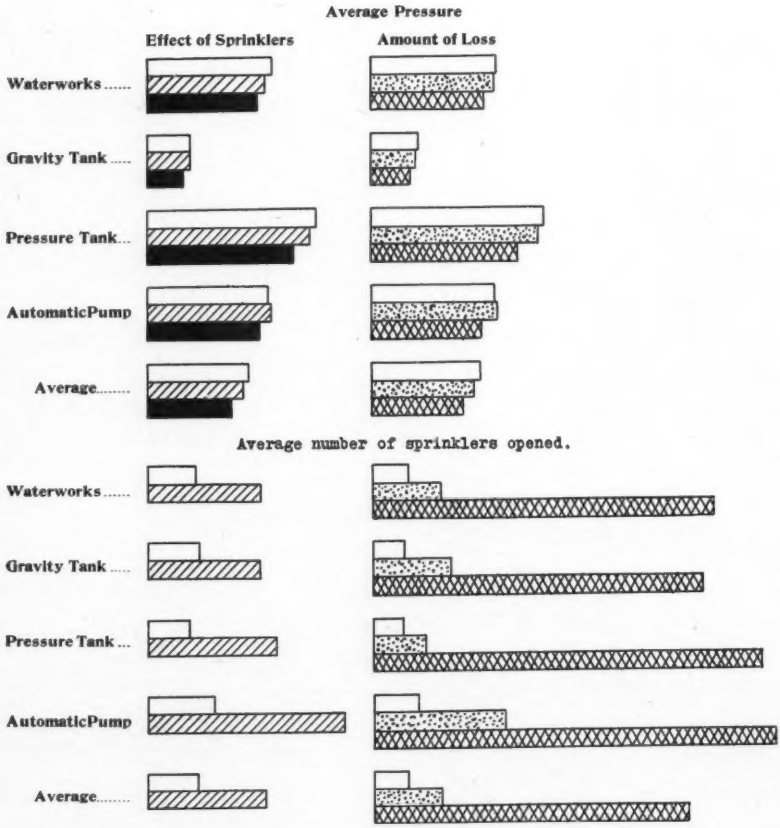

Chart 3

(See key under Chart 2.)

Primary Water Supply	Average Pressure			Average Number Sprinklers Opened		
	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)		Held fire in check
Water works,	68	64	60	5.19		12.24
Gravity tank,	24	24	20	5.59		12.10
Pressure tank,	92	88	79	4.35		13.68
Automatic pump,	66	67	61	7.13		21.01
Average	56	52	46	5.29		12.65
	No claim	Small loss	Large loss	No claim	Small loss	Large loss
Water works,	67	66	60	3.87	7.29	36.7
Gravity tank,	25	24	21	3.39	8.39	35.6
Pressure tank,	93	90	78	3.29	5.70	41.8
Automatic pump,	66	68	59	4.97	14.22	43.3
Average	58	54	49	3.69	7.75	37.5

This chart offers a means for comparing the pressure and number of sprinklers opening for different systems as well as for fires extinguished, held in check, no claim, small loss, etc., for the same system. The first noticeable fact is that in every case the average pressure is the lowest value for unsatisfactory or large loss fires. However, the pressure for such fires is not decidedly less, nor does it present such a difference as exists between the average pressures of the various systems. The comparatively low pressure of the gravity tank is emphasized. This low average pressure for the gravity tank presumably must have been somewhat of a draw-back to such a system but not as great as one might imagine, as is evidenced by the comparative results shown in chart 2. The average number of sprinklers opening shows some interesting features. Note the tremendous increase of heads opening under large loss fires and the generally higher value throughout for the automatic pump.

Efficiency of Water Pressures

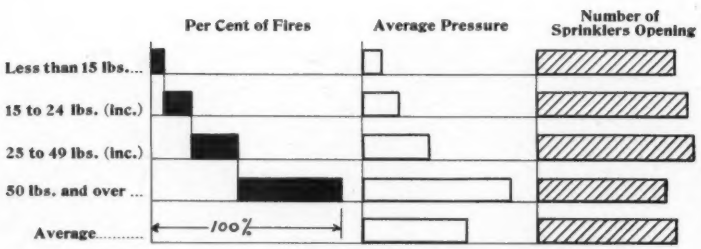

Chart 4

Pressure on Sprinklers	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened
Less than 15 lbs.,	380	6.6	10	7.33
15 to 24 inclusive,	846	14.6	19	7.98
25 to 49 inclusive,	1416	24.5	35	8.30
50 and over,	3140	54.3	78	6.83
Total or Average	5782	100.0	54.6	7.39

Water supplies are analyzed here from the point of view of pressure. More than one-half of the systems had a pressure of fifty pounds or over. The relative number of heads opening for the different pressures does not vary widely, although the best showing is made by the highest pressures.

Efficiency of Water Pressures

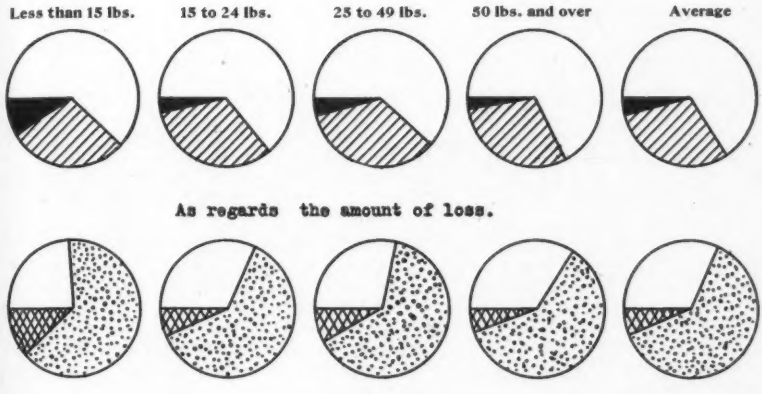

Chart 5

(See key under Chart 2)

Pressure on Sprinklers	Per Cent. of Fires			Per Cent. of Fires		
	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	No claim	Small loss	Large loss
Less than 15 lbs.,	61.9	29.2	8.9	23.7	64.2	12.1
15 to 24 inclusive,	64.4	32.5	3.1	31.8	61.3	6.9
25 to 49 inclusive,	61.5	34.7	3.8	29.6	62.7	7.7
50 and over,	68.4	28.9	2.7	34.7	59.3	6.0
Average	65.7	30.9	3.4	32.3	60.8	6.9

This chart gives an opportunity to compare the results obtained through systems of different pressures. The low pressure of less than fifteen pounds is obviously the poorest both in respect to unsatisfactory and large loss fires. However, the variation between the other groups is not very great, although in general the showing is better for the higher pressures. The smaller percentage of no claim fires for the pressures of less than fifteen pounds is also an interesting point to be noted.

Efficiency of Wet and Dry Systems

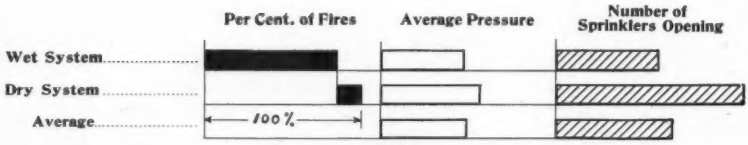

Chart 6

Wet or Dry System	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened
Wet system,	4872	84.2	53	6.54
Dry system,	910	15.8	63	11.97
Total or Average	5782	100.0	54.6	7.39

Probably no question in respect to automatic sprinklers has been the subject of a greater difference of opinion than the relative merits of the wet and dry system. It is hoped that these charts may serve to answer some of the disputed questions. Chart 6 shows the relatively small percentage of fires which occurred where there were dry pipe systems. It also brings out the fact that the average pressure in dry systems was slightly higher and that the average number of heads opening was much greater, approximately 1.8 times as many as in the wet system. The necessity for a liberal water supply in dry systems is apparent.

Efficiency of Wet and Dry Systems

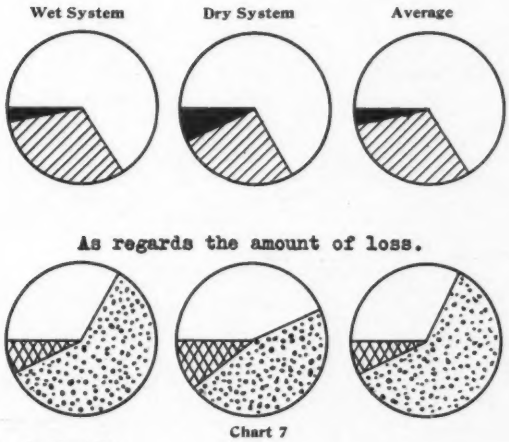

Chart 7

(See key under Chart 2)

Wet or Dry System	Per Cent. of Fires			Per Cent. of Fires		
	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	No claim	Small loss	Large loss
Wet system,	65.6	31.5	2.9	30.3	63.4	6.3
Dry system,	66.4	27.3	6.4	42.8	46.7	10.4
Average	65.7	30.9	3.4	32.3	60.8	6.9

This chart provides an opportunity for directly comparing the two systems with one another and also with the average for all systems. The showing of the dry pipe system is decidedly the poorer both from the number of large loss and unsatisfactory fires. The probability of a large loss fire with a dry pipe system is 1.65 times as great as in the case of a wet system. It should be noted, however, that the no claim fires are appreciably greater in the dry system.

Efficiency of Wet and Dry Systems

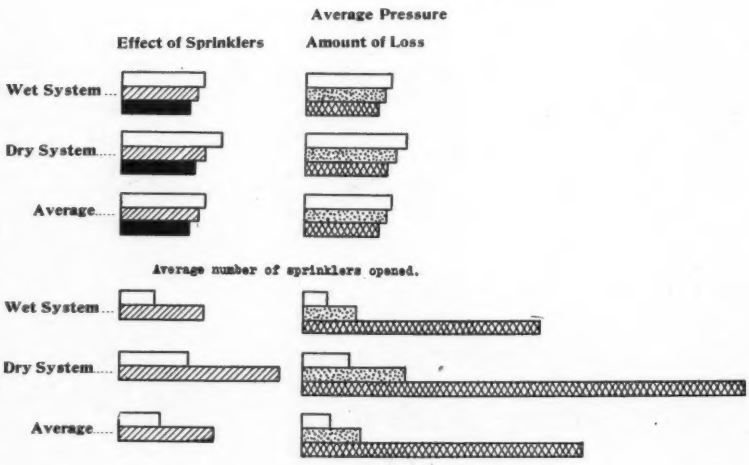

Chart 8

(See key under Chart 2)

Wet or Dry System	Average Pressure			Average Number Sprinklers Opened			Average Pressure			Average Number Sprinklers Opened	
	No Claim	Small Loss	Large Loss	No Claim	Small Loss	Large Loss	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Wet system,	56	53	47	3.03	6.97	31.7	55	51	45	4.54	11.26
Dry system,	67	60	54	6.16	13.54	59.4	67	56	49	9.24	21.45
Average	58	54	49	3.69	7.75	37.5	56	52	46	5.29	12.65

The final chart emphasizes the very large number of heads opening in dry systems, particularly in the case of large loss fires. The effect of different water pressures in the two systems does not seem to have been a factor. Apparently the time element necessary for water to reach a fire through the dry pipe system is an important factor and results in a greater number of heads opening than in the wet system.

Conclusions.

The discussion given has covered only the more prominent points brought out by these charts. The entire table is given in order that the reader may make a more detailed study of the subject. There are a few points which have been pretty clearly shown and may be summarized as follows:

(1) The pressure tank has the lowest value for large loss fires and number of heads opening and unsatisfactory fires. It has the highest percentage of no claim fires.

(2) The automatic pump may be said to represent the other extreme from the pressure tank. The number of unsatisfactory and large loss fires is greatest in equipments having automatic pumps.

(3) Equipments having pressures under fifteen pounds show a decidedly higher percentage of large loss and unsatisfactory fires. The showing improves slightly with an increase of pressure but there is no marked superiority between pressures of over twenty-five pounds and those under.

(4) The dry system has a much higher average number of heads opening than the wet system and also a much poorer showing in respect to large loss and unsatisfactory fires.

EFFICIENCY OF WATER SUPPLIES TO SPRINKLER SYSTEMS.

Primary Water Supply.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number of Fires.			Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened.	
					Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Water works,	2961	51.2	66	7.42	1857	1004	100	62.6	34.0	3.4	68	64	60	5.19	12.24
Gravity tank,	1938	33.5	24	7.40	1259	604	75	65.0	31.1	3.9	24	24	20	5.59	12.10
Pressure tank,	627	10.9	91	5.72	517	98	98	82.5	15.6	1.9	92	88	79	4.35	13.68
Automatic pump,	256	4.4	66	11.06	164	79	13	64.1	30.8	5.1	66	67	61	7.13	21.01
Total or average	5782	100.0	54.6	7.39	3797	1785	200	65.7	30.9	3.4	56	52	46	5.29	12.65

EFFICIENCY OF WATER PRESSURES ON SPRINKLER SYSTEMS.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number of Fires.			Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened.	
					Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Less than 15 lbs.,	380	6.6	10	7.33	235	111	34	61.9	29.2	8.9	10	10	10	6.67	11.01
15 to 24 inclusive,	846	14.6	19	7.98	545	275	26	64.4	32.5	3.1	19	18	18	5.46	13.77
25 to 49 inclusive,	1416	24.5	35	8.30	871	491	54	61.5	34.7	3.8	35	36	37	5.78	13.67
50 and over,	3140	54.3	78	6.83	2146	908	86	68.4	28.9	2.7	80	76	74	4.91	11.96
Total or average,	5782	100.0	54.6	7.39	3797	1785	200	65.7	30.9	3.4	56	52	46	5.29	12.65

EFFICIENCY OF WET OR DRY SPRINKLER SYSTEMS.

Wet or Dry System.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number of Fires.			Per Cent. of Fires.			Average Pressure.			Average Number Sprinklers Opened.	
					Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check	Unsatisfactory	Extinguished fire (or practically extinguished)	Held fire in check
Wet system,	4872	84.2	53	6.54	3193	1537	142	65.6	31.5	2.9	55	51	45	4.54	11.26
Dry system,	910	15.8	63	11.97	604	248	58	66.4	27.3	6.4	67	56	49	9.24	21.45
Total or average,	5782	100.0	54.6	7.39	3797	1785	200	65.7	30.9	3.4	56	52	46	5.29	12.65

EFFICIENCY OF WATER SUPPLIES TO SPRINKLER SYSTEMS. — As Regards Amount of Loss.

Primary Water Supply.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number of Fires. No claim	U	Small loss	U	Large loss	U	Per Cent. of Fires. No claim	Small loss	Large loss	Average Pressure. No claim	Small loss	Large loss	Average Number Sprinklers Opened. No claim	Small loss	Large loss
Water works,	2961	51.2	66	7.42	816		1932	18	213	82	27.6	65.2	7.2	67	66	60	3.87	7.29	36.7
Gravity tank,	1938	33.5	24	7.40	602	1	1210	12	126	62	31.1	62.4	6.5	25	24	21	3.39	8.39	35.6
Pressure tank,	627	10.9	91	5.72	326		268	3	33	9	52.0	42.7	5.3	93	90	78	3.29	5.70	41.8
Automatic pump,	256	4.4	66	11.06	124		104	3	28	10	48.4	40.7	10.9	66	68	59	4.97	14.22	43.3
Total or average,	5782	100.0	54.6	7.39	1868	1	3514	36	400	163	32.3	60.8	6.9	58	54	49	3.69	7.75	37.5

EFFICIENCY OF WATER PRESSURES ON SPRINKLER SYSTEMS. — As Regards Amount of Loss.

Pressure on Sprinklers.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number of Fires. No claim	U	Small loss	U	Large loss	U	Per Cent. of Fires. No claim	Small loss	Large loss	Average Pressure. No claim	Small loss	Large loss	Average Number Sprinklers Opened. No claim	Small loss	Large loss
Less than 15 lbs.,	380	6.6	10	7.33	90		244	4	46	30	23.7	64.2	12.1	10	10	10	3.55	8.94	20.2
15 to 24 inclusive,	846	14.6	19	7.98	269		519	8	58	18	31.8	61.3	6.9	19	19	19	3.17	7.61	50.5
25 to 49 inclusive,	1416	24.5	35	8.30	419	1	888	6	109	47	29.6	62.7	7.7	35	36	35	4.13	8.52	40.6
50 and over,	3140	54.3	78	6.83	1090		1863	18	187	68	34.7	59.3	6.0	80	78	75	3.65	7.28	33.7
Total or average	5782	100.0	54.6	7.39	1868	1	3514	36	400	163	32.3	60.8	6.9	58	54	49	3.69	7.75	37.5

EFFICIENCY OF WET OR DRY SPRINKLER SYSTEMS. — As Regards Amount of Loss.

Wet or Dry System.	Number of fires	Per cent. of fires	Average pressure	Average number sprinklers opened	Number of Fires. No claim	U	Small loss	U	Large loss	U	Per Cent. of Fires. No claim	Small loss	Large loss	Average Pressure. No claim	Small loss	Large loss	Average Number Sprinklers Opened. No claim	Small loss	Large loss
Wet system,	4872	84.2	53	6.54	1478	1	3089	24	305	117	30.3	63.4	6.3	56	53	47	3.03	6.97	31.7
Dry system,	910	15.8	63	11.97	390		425	12	95	46	42.8	46.7	10.4	67	60	54	6.16	13.54	59.4
Total or average	5782	100.0	54.6	7.39	1868	1	3514	36	400	163	32.3	60.8	6.9	58	54	49	3.69	7.75	37.5

Note—"Average number of sprinklers opened" does not in any case include the Unsatisfactory fires.
U. Unsatisfactory fires.

General Fire Record

Unsatisfactory or Serious Fires in Buildings Equipped with Sprinklers.

Where sprinklers fail the cause is, almost invariably, clear. These fires are selected to indicate such causes, that they may be generally understood and satisfactorily met.

S-18010. This brick building was two stories in height, open finish, joist floors, with a basement extending under the entire length. The basement ceiling was also open-joist construction.

Fire started from a hot shaft-bearing in a corner of the unexcavated and unsprinklered part of the basement, and spread to the floor above. The sprinklers on the first floor opened and appeared to check the fire, but on account of the large amount of smoke they were allowed to continue operating until the water supply was exhausted. When the water gave out, the fire was still burning throughout the basement and soon the plant was almost entirely destroyed.

This fire which resulted in a loss of $128,000 very clearly emphasizes the necessity of having sprinklers installed in every part of the basement, for had there been sprinklers in the basement of this building such a large loss would unquestionably have been prevented.

Summary: Unsprinklered portions.

S-17571. This fire occurred in a brick machine shop, three stories, attic and basement with plank and joist floors. The building was sprinklered throughout excepting in a low basement. Sprinklers were supplied from one steam and one electric pump, private reservoir, and a primary supply from a six-inch pipe from the public waterworks system which gave a pressure of sixty-five pounds.

A workman, who came into the machine shop early before the electric lights were turned on, lighted a piece of paper with which to see. When this had burned close to his hands he threw it down, as he supposed, into the tail race but instead it lodged on some combustible material in the basement and immediately started a fire which extended under the whole lower floor over the low unsprinklered basement. This floor was thoroughly oil-soaked from long use as a machine shop. The fire extended

up through the building along the openings and walls. The smoke was very dense and one employee was overcome by it and lost his life.

The mill fire brigade and public department finally extinguished the fire. The oily condition of the floors was a considerable factor in the rapid spread of the flames. In about an hour the heat under the main floor had become so great that the steel girders which spanned the tail race collapsed and a portion of the tail race fell. As the posts supporting the corresponding sections of the second and third floors and roof rested on the steel girders which failed, they also came down bringing with them a large quantity of stock, machine tools, machines and supplies into the water and mud below. The loss consisted principally of damage to machines, tools and stock and amounted to $26,580.00.

This is another fire which resulted in a large loss, primarily because the basement of the building was not equipped with sprinklers.

Summary: Unsprinklered portions.

S-17858. This large fibre plant, which covered a considerable area, consisted mainly of a close group of stone buildings, one and two stories in height with frame and frame iron-clad additions and extensions. There were no cut-offs of any consequence although the stone buildings were divided into several sections by a fair fire check. Internal construction in general was of light, semi-mill type.

This factory manufactures indurated fibreware and hard fibre insulation for electrical work from ground wood and sulphite pulp, waste paper, resin, linseed oil, and tar. It is usually prepared from ground wood and sulphite pulp and waste paper run through beaters and storage chests in basement of No. 1 building, thence through various hydraulic press machines where the product is formed for fibreware. The product is then dried in rooms heated by steam coils and hot air, trimmed to proper size, sanded and dipped in tanks in the treating room in a solution of linseed oil, resin and fuel oil. The material is next baked in ovens of No. 4 building, heated with steam coils for about ten hours, re-sanded, dipped for the final coating and baked in ovens in either No. 4 or No. 6 building. It is then ready for trimming, finishing and packing. In manufacturing conduit the same stock is used. It is run over rolls under hydraulic pressure, dried in hot air ovens in new dry room building east of No. 1, then dipped in impregnating tanks of hot tar, drawn out and allowed to drip, then finished in lathe room by cutting and shaping ends. In the manufacture of fibre insulation the same raw stock is used, pressed into tubes or sheets under hydraulic rolls to forms desired, soaked in acid solution and then dried in dry rooms by hot air methods. The dry rooms were in continuous operation; the remainder of the plant worked only in the daytime. There were no exposures other than those mutually created between buildings of the plant.

Fire occurred at 12.10 a. m. from lightning which struck the plant in three places at the same time, namely, the impregnating building, No. 4 treating building and No. 6 bake-oven building. Fire was immediately discovered by employees at work in the plant and an alarm was sent in

from a box located in the mill yard. Watchman was on duty with good watch-clock service.

The inside protection consisted of water and sand pails, chemical extinguishers and hand hose, but these were of little value. Outside protection consisted of a paid company of five men with combination chemical wagon, who responded within four minutes of the time alarm was received and found yard hydrants in use by the mill private brigade. They therefore laid one line with about 900 feet of hose from a hydrant located near the power house of an adjoining plant which was supplied by a four-inch branch from an eight-inch main which also supplied the private fire protection system of the fibre plant. Very little service could be obtained from this line and in the meantime the private fire brigade of the plant had two and, at times, three hose streams from hydrants in mill yard. The fire pump was started, but little pressure appeared to be available.

The main plant was equipped with automatic sprinklers which covered the greater portion of the buildings, with the exception of the impregnating building and the new dry room on the east side of No. 2 dry house, which were not equipped.

The fire in the impregnating building, which contained the tar dipping tanks, gained rapid headway and almost immediately spread to the unsprinklered frame addition to the east side of No. 2 dry house, passing through numerous openings in stone division wall between this and No. 2 dry house, which was sprinklered, and involving the first dryer in this section, opening probably fifty heads. The fires which started in No. 6 and No. 4 buildings were promptly extinguished by ten sprinkler heads at each location. A small blaze on the roof of No. 6 was extinguished with hand chemicals in addition to the sprinklers. The fire rapidly worked into No. 2 dry house after consuming the entire unsprinklered addition on the east end thereof and a large number of open heads in this location bled the entire system. Although the pump was maintained at full speed during this time no effective streams could be had, nor was the work of the sprinklers here in any way effective other than as a check to the spread of fire in No. 2. The fire by this time had spread from the impregnating building into the loading shed on the north side of the new dry room and from this point both east and west. The roof of the east side of No. 2 dry house had fallen in, thereby assisting in bleeding the entire system. At this time two streams were laid from a 400-gallon rotary pump in pulp mill on the south side of the creek operated either by turbine wheel or electric motor. The latter power was used at this time. Two good streams were obtained from this source. They were carried across the stream on passageway and up to the roof of No. 1 press room and were used to cut off the fire at the frame wall on the east end of new tube building section, which was the limit reached in this building, but the flames swept rapidly eastward through the new dryer building and entirely consumed this section, as the only real protection available at this time was that obtained from rotary pump in the pulp

mill. The fire was under control at about 4.30 a.m., after the impregnating building, the east end of No. 2 dry house, and the new dryer building had been entirely destroyed.

The primary water supply to the sprinkler and yard hydrant system is an eight-inch main with a normal static pressure of about 130 pounds in the street or 120 pounds at the level of the plant itself. There is an eight-inch connection from the aforesaid main to a six-inch and eight-inch loop around the plant, and from this eight-inch connection a twelve-inch pump suction is taken off for a 1000-gallon steam fire pump in detached building which has an auxiliary suction to two 45,000-gallon tanks. This pump is connected directly into the six-inch yard hydrant and sprinkler loop around the buildings, properly checked.

Tests made on the eight-inch street main showed that a delivery of 1000 gallons per minute at the level of the plant for fire pump suction could not be had and that the capacity of this main with adequate residual pressure was approximately 500 gallons per minute. The opening of the sprinkler heads in No. 6 and No. 4 buildings in itself nearly exhausted the capacity of this main for effective service and left little head available for yard hydrant streams and the sprinklers opening subsequently. This was promptly demonstrated as soon as the fire from the impregnating building communicated to the unsprinklered addition to No. 2 dry house and opened a large number of heads in the easterly end of the latter.

The effect of sprinklers in the sprinklered sections, namely, No. 2 and No. 6 buildings, was to practically extinguish the fires originating in these buildings with the exception of an outside blaze on a small roof structure, which was put out by a hand chemical. The sprinklers in No. 2 dry room held the fire in check from the exposure fire to a considerable degree, although the large number which opened, including the twenty heads in No. 4 and No. 6 buildings which were left flowing, bled the system to such an extent that effective yard hydrant streams were not available. The sprinklers in the new dry house building were of no use for when the fire reached this point the system was bled to such an extent that no supply was available for this section.

The total loss will amount to probably thirty per cent of the sound values involved. The reason for this large loss may be assigned directly to the lack of sprinkler protection in the hazardous impregnating building and the equally hazardous dry room adjoining the No. 2 main dry house in the center of the plant. The water supply was inadequate to supply the large number of heads which finally opened, although it would probably have been sufficient to have controlled a fire in the impregnating room had that section been sprinklered.

The manufacturing hazard in this plant is exceptionally severe and the construction of the wooden dry rooms would favor the spread of the fire even under ordinary conditions and good protection.

The lessons to be learned from this fire are the necessity for the proper sprinkler protection for all sections of such manufacturing plants, and the exceptional hazard of unsprinklered sections exposing or adjoining

sprinklered portions of buildings of this character, class and occupancy. The necessity for proper outside control is also demonstrated in the inability of the fire department to shut off the sprinklers in the new dryer building.

Summary: Unsprinklered portions.

S-18042. Oilcloth and Linoleum Factory. This building was four stories in height with brick walls and open finish, and joist floors. Building was equipped with automatic sprinklers (286 degree heads) installed on old standard pipe sizes. The primary water supply consisted of four gravity tanks with a total capacity of 44,700 gallons. Static pressure on sprinklers operating was twenty-five pounds. The secondary supply to sprinklers was two steam pumps, each having a capacity of 1000 gallons.

Fire occurred in building No. 6 which was occupied entirely for coating and drying oilcloth. There was a space at the west end of each floor occupied by the coating mills and the balance of the floor was occupied as a dry room, being separated from the coating room by a frame partition. Table oilcloth was coated with a paint mixture (containing a little benzine) in the coating mills at west end of the building and then run into the dry rooms and hung in festoons about eight feet high and the length of dry rooms, or about eighty-three feet. Dry rooms were ten feet high and there was a space of ten inches between the bottom of joists and the small sticks carrying the festoons of oilcloth. There was a line of sprinklers over each roll of cloth, these lines being seven feet apart, and the sprinklers were spaced eight feet apart across joists, down the length of the dryer. The sprinklers were on the end of three-inch nipples to one side of the pipes and also raised up a little in order to be more out of the way of the cloth in the racks below. This placed the sprinklers slightly at an angle so that the distribution was somewhat interfered with and they were, therefore, only about two inches below the bottom of joists, and the bottom of the deflectors of the sprinklers (heads were placed pendant) was only six inches above the sticks carrying the festoons of oilcloth. All the sprinklers were 286 degree heads. All of the dry rooms on each floor of building were filled with table oilcloth, most of which had been coated and run into dryers the day before fire occurred. Some of this oilcloth had also been varnished.

Fire was discovered at 2 a.m. by the sprinkler alarms and the head watchman immediately blew the mill whistle which assembled the men at night work. They at once got out the chemical engine and hurried toward the building which was then a mass of flames. A public fire alarm had also been sent in.

It was apparent that almost from the start the fire was not controlled by the sprinklers and must have gained rapid headway even after the first heads opened. Apparently some of the sprinklers were obstructed and although they opened early in the start of the fire they did not prevent the flames from getting beyond their control. The fact that all the sprinklers were 286 degree heads was presumably a factor in making their operation slow. A second and third alarm was turned in at 3 a.m. and a great

many hose streams were played on the fire. During the progress of the fire several firemen were on the roof of the one-story building adjoining on the north directing hose streams through windows of building No. 6 when, without warning, over half of the north wall on building No. 6 fell onto this roof, burying the men under tons of brick and crushing in the greater part of the roof. **Two of the men were killed and several were severely injured.** The sudden failure of this wall is in part attributed to the tremendous amount of water which was poured into the building and held there by the oilcloth.

The very satisfactory operation of the automatic fire doors in a large measure prevented the fire from gaining access to adjacent buildings. The fire was finally extinguished by the fire department and resulted in a very heavy loss to the building in which it originated. An examination of the ruins showed that quite a number of the sprinklers in the coating room at west end of building had not opened, and on the second floor of drying rooms, where portions of the ceiling were still standing, a number of sprinklers had not opened although the heat in all the portions noted would seem to have been intense. It had been suggested several times that 212 degree heads should be used instead of 286 degree heads.

Summary: High degree heads and obstruction to distribution.

S-17893. Fire occurred on the sixth floor of this building which was occupied as a stock room of a sweater and bathing-suit manufacturer. Fire had gained considerable headway when discovered and had spread over top of wooden table among wrapping cord, burlap, paper, etc., and thence to stock shelves directly in back of table. Fire occurred at a point between non-staggered sprinklers where the distribution of water was obstructed by wooden partitions and shelves. The sprinklers in the immediate vicinity of the fire showed signs of having been painted and were unquestionably slow in operating. This fact together with obstructions and non-staggering of sprinklers allowed fire to spread rapidly. The heat caused the operation of fifty-three sprinkler heads, although the fire was confined to an area covered by four or five. Since this was the top story of the building the sprinklers were further hampered by low water pressure from the gravity tank supply which was only nine pounds on highest line of sprinklers. In spite of the fact that the conditions described herein were unfavorable to positive sprinkler control, it is of interest to note that the sprinkler system held the fire in check and confined it to a small area until the arrival of the fire department.

S-18063. Cotton Mill. Two workmen were making repairs to the piping in the engine room basement near the fly wheel. They needed artificial light and a gas torch attached to the gas burner in the basement was used. An accumulation of lint and grease in the wooden enclosure around the fly wheel became ignited and burned rapidly as there were no sprinklers inside this enclosure. The unsprinklered wooden casing of the fly wheel and the wooden belt boxing in the room directly over it together with the belts furnished sufficient fuel for the fire to make good

headway. Flames spread up through the belt room but were prevented from entering the mill proper on each floor by the operation of sprinklers. The main belting was destroyed while nineteen cards were wet and there was considerable damage to ring spinning frames and to about 200 frames in the first two stories. In the upper stories the counter belts driving the two upper floors of the mill passed out through the wall of the tower without protection for the openings thus formed and were a factor in causing the loss of approximately $10,000.

S-17819. This fire occurred in a silk shoddy mill and was extinguished with fire pails, chemicals and three private hose streams. The sprinklers were a failure. Modern 360° heads in glass covers had recently been installed in the dryers and although examination of the heads afterwards showed them to be apparently in good condition, they did not operate at the time of fire. It would appear that the high temperature solder together with the glass tops had raised the operating point too high.

Summary: High test heads.

Motion Picture Film Fires.

Two Recent Fires in These Properties in New York and Atlanta.

H-11245. New York City. The property in which this fire occurred was a five-story and basement ordinary brick building with two brick basement extensions; area 17,000 square feet. The finish was open except for a small part of the first floor and a small portion of the second floor which was metal sheathed on wood furring. There were very few partitions in the building and these were either wood or metal on wood studding. The floors in part of the fourth floor were one-inch cement on one-inch wood; in the rest of the building they were constructed of one-inch wood on one-inch wood supported by heavy joist construction on wood girders or steel girders and cast iron columns. The ceilings were partially metal in the first, second, third and fourth floors and wood in the rest.

Floor Openings: There were two iron stairways with stone treads and landings from the basement to the fourth floor only, in separate sixteen and twelve-inch brick shafts, with ordinary wood doors opening upon the fourth floor and two-ply metal covered doors, which were in very poor operating condition, upon the other floors; two open wooden stairways from the fourth to fifth floor; a continuous wood stair hallway from first to fourth floor, with numerous wood doors; two elevators in separate brick shafts with single iron doors or sub-standard metal covered panel doors with upper panels of wired glass to each floor. Besides these large openings there were several small openings between the different floors for belts or other purposes. There were no party walls

Occupancy: Basement—boiler room and storage of printers' supplies; first floor—lithographing and printing establishment; second floor—corrugated paper work room, also manufacturing dress trimmings; third floor—braid works, also stock of property for moving picture studio (mostly wood furniture); fourth floor—large stock of property and theatrical costumes of a moving picture studio, 2000 feet of film in cans in double-wall metal cabinet, seventy to eighty reels in cans in one single-wall metal cabinet, forty-two pockets with about 500 feet of open film in each pocket in single-wall metal cabinet, four or five pounds of gun-powder and about 2000 blank cartridges on this floor; fifth floor---same tenant, offices and studio. A double-wall metal cabinet fastened to the east wall of the building contained ten reels of films not in cans, 18,000 feet of film in wood drawers, five cans each with 400 feet of film, also a few small rolls of film on wood shelves.

Protection: There were fire pails and hand extinguishers on both the third and fourth floors, also four four-inch standpipes with two and a half-inch linen hose attached at outlets on each floor supplied from two outside Siamese connections to the fire department and one steam pump taking suction from city mains.

The fire started shortly after 7 p.m. While the watchman was making his rounds he noticed smoke coming from the stair hall on the third floor at the east end of the building, which was occupied by the braid works. He opened the door at the head of the stairs on the fourth floor and found the hall full of smoke. He shut the door immediately and rang the private alarm.

The cause of the fire is unknown. The easterly stairway was enclosed in a continuous hall of wood partitions with wood doors to each story. Fire communicated through this stair hall to the fourth floor, occupied by the film company, which contained a large amount of inflammable material. The fire spread very rapidly in a spectacular manner owing to the large amount of combustible stock in the upper floors of this building, including nitro-cellulose films on the fourth floor, together with the gun powder, blank cartridges and combustible film in other portions of this floor.

There were five public alarms which called out a total of twenty-six engines, two water towers, six hook-and-ladder trucks, one searchlight and one rescue company. It was several hours before the fire was under control and over a day before it was completely extinguished. The fire was fought largely with the high pressure service using a pressure varying from 175 to 200 pounds. This high pressure caused a number of hose lengths to burst but did not seriously hinder the work of the department as there were so many streams in use.

Damage: The fourth and fifth floors, which were occupied by the film company, were practically gutted, also the easterly portion of the third floor which was occupied by the braid company. All the film that was in the single wall metal cabinet, located in a metal lined room with metal covered self-closing doors on the fourth floor, was entirely burned. The contents of the double-wall metal cabinet fastened to the east wall of the fifth floor, were not damaged by fire except that the loose films were melted together at the edges. This cabinet was constructed of inner and outer walls of twelve gauge metal plates reinforced with angle iron frames at the edges. Two sets of manually operated doors with one-inch air space between inner and outer doors made up the entire front of the cabinet. The cooling effect of the immense amount of water poured on this fire in all probability helped to keep this cabinet from failing. If the cabinet had not been fastened to the wall of the building it would have fallen when the floors collapsed and in all probability broken open, allowing the contents to burn.

Conclusions: The importance of segregating motion picture studios and factories, and the necessity for automatic sprinklers in connection

therewith, were illustrated by the fact that the contents of the film factory furnished exceptionally inflammable fuel for the fire which apparently originated on the premises of another occupant.

The importance of using partitions made of fire resisting materials to enclose rooms in which inflammable motion picture films are being handled was demonstrated by the failure of the metal partitions on wooden studs used to enclose the printing, perforating and developing rooms on the fourth floor.

The desirability of providing a separate metal container for each reel of film was indicated by the relatively small amount of damage to films in individual metal cans as compared to the damage to films without such cans stored under like conditions in cabinets or other containers.

This fire is another example of the effect of unprotected and poorly protected floor openings, showing the rapidity with which fire communicates from one floor to another through such openings.

H-11255. Atlanta, Georgia. This property consisted of a two-story and basement brick building fifty by ninety feet. Floors were ordinary wood joisted; ceilings sheathed with three-ply painted paper board, forming concealed spaces between floor joists and the ceiling and roof. The entire finish was of wood. The building was divided into two sections, each twenty-five by ninety feet. The basement of the first section was occupied by general electrical supplies and contractors' stock; first floor, offices; second floor, stock room and motion picture machine room, also used for motion picture film repairing and rewinding. The basement of the second section was used for the storage of posters and advertising matter belonging to a film company; first floor, offices, motion picture film exchange, repairing and rewinding, cleaning and shipping; second floor, stock room and general storage of posters and advertising matter.

The fire occurred at 2.35 p.m., and the evidence seems to establish the fact that it was directly caused by an electric short circuit in an attachment plug used to connect a desk fan to a drop-light socket. A careful examination of the fan and connection, which it was claimed by employees who were eye witnesses of the origin of the fire caused the fire, showed that there was undoubtedly a short circuit in the porcelain and composition attachment plug that was found screwed into a drop-light circuit directly over the film title cabinet. This circuit was traced to the fuse cabinets and a fuse in one side of the cabinet was found blown, thus corroborating the evidence given above.

Fire was fought and extinguished by the public fire department. Practically all the roof and the inside of second floor and about half of the inside of the first floor of the building were a total loss.

Three young women employees of the film company were killed; one seriously injured by burns and broken limbs; and two others less seriously burned. One man was painfully burned and received a broken ankle. Several other men and young boys were more or less burned and suffered minor injuries in their escape from the building.

A previous inspection had brought out the following criticisms of conditions:

(1) No fireproof vault nor approved safes for storage of films.

(2) Examining and repairing done in main room where combustible materials were stored and not partitioned off.

(3) Films under examination were not enclosed in magazines.

Other prominent defects are: (1) safes for storage of films were not provided with vents to the outside; (2) cabinet or safe for storage of titles was built of wood and not provided with doors; (The short circuit in attachment plug already described occurred above and a little to the front of this open film cabinet). (3) partitions in building were of light wood construction and oiled and varnished; (4) a large number of films in rewinding and repairing room were not enclosed in metal magazines (as many as fifteen were found on one table).

From the above it will be seen that proper precautions were not observed, nor were proper devices provided for the safeguarding of inflammable materials and the prevention of such serious losses both to life and property in a plant of this class which carries with it such well known and recognized hazards. A most noteworthy feature of this fire is the very rapid spread of the flames to all parts of the building, especially to the entire second floor. Reputable eye-witnesses stated that the entire second floor was ablaze and filled with dense smoke and gases within three minutes after the first flash occurred on the first floor. This rapid spread of the flames to the second floor was undoubtedly due to poor construction, the use of light and inflammable material for ceiling, and lack of proper fire stops between floor and ceiling joists where they rested on the wall plate of the stairway partition. The material used for ceiling in this plant was three-ply paper board which was tacked directly to the bottom of second floor joists and painted to represent metal. The second floor joists rested on the wall plate of the stairway partition which was wood studding, metal lath and plaster on first floor only; above the ceiling line of the first floor this partition was light wood ceiling and burned very rapidly. The spaces between second floor joist communicated directly to stair shaft, and as soon as the paper ceiling was burned the flames and smoke, increased by the natural draft in the stairway enclosure, spread rapidly to second floor and through the various offices and rooms which were separated by light wood and glass, oiled and varnished partitions.

The loss of life as a result of this fire was due largely, if not entirely, to the defects in construction just mentioned, and secondly to the obstruction of the rear windows with work benches and boards nailed over lower part of windows.

Points of Interest from Fire Reports.

These notes are intended to illustrate the efficiency or inefficiency of signaling, retardant or extinguishing agencies.

Automatic Sprinklers.

S-18241. Fire occurred in a room where practically all the stock of pyroxylin plastic was kept and where the covers were stamped out of thin sheets of that material. Ten sprinklers operated and so effective was their work that finished stock on wooden benches five feet distant from the center of the fire did not burn and several cans of coloring fluid, lacquer and amyl acetate under benches in center of fire area were unaffected. Altogether about 5000 gallons of water were discharged by the sprinklers.

This is another good illustration of the very efficient manner in which automatic sprinklers can control a severe hazard.

S-17853. An investigation showed that there were eighteen inches of water on the basement floor which came from a broken connection at the base of the sprinkler riser under the floor. This was caused by the failure of a joint where a six-inch elbow was connected to the universal pipe of the underground system. This joint probably blew out when the fire pump started up under the automatic governor. The defective joint was of the earlier type of universal fitting in which the elbow did not have lugs cast on it to correspond with the lugs on the pipe, but reliance was placed upon separate clips which locked over a flange on the fitting. There were two bolts to a joint but examination showed them to be badly corroded.

S-17565. This fire was unquestionably of incendiary origin. It started in two places at the same time, one blaze occurring in a pile of bags containing sweepings, the other in a shoe rack several feet away. Three of the sprinklers near the fire were covered with asbestos paper which was tied on, and the sprinkler alarm was disconnected. Fortunately the other sprinklers in the room opened promptly and practically extinguished the fire. Loss amounted to $4,300.

S-17880. Storage Warehouse. This one-story frame and corrugated iron pier of ordinary construction was occupied for the storage of cotton. About 3 a.m. fire broke out among considerable cotton stored in section 3, from some unknown cause. There were about 10,000 bales of cotton in this section, arranged with five-foot aisles every fifteen feet. Cotton was piled seven bales high. Fire was discovered by watchman

whose attention was directed to it by sprinkler alarm. Watchman promptly sent in alarm from auxiliary box. Sprinkler alarm was also transmitted to fire headquarters. One hundred and nineteen sprinklers operated under a pressure of from 80 to 100 pounds and prevented the fire from spreading. Sprinkler equipment was in operation for about one hour and ten minutes. It is stated that large tarpaulins have of late been placed in front of cotton piles on this pier in order to prevent possible sparks from locomotives, which are obliged to pass this section occasionally, from igniting cotton. Locomotives, however, are provided with spark arresters. Fire was extinguished by the fire department with about ten hose streams. Skylights were broken out to permit the escape of dense smoke. It is estimated that about 1,000 bales of cotton were considerably burned and the entire lot of 10,000 bales thoroughly soaked with water. There was absolutely no damage to pier structure other than the breaking of the skylights by the fire department. In spite of the presence of tarpaulins, which interfered somewhat with the operation of sprinkler equipment, there is no question that sprinkler protection prevented a very serious fire.

Chemical Extinguishers.

S-17486. Fire was discovered by an employee who immediately started to use a two and one-half gallon chemical extinguisher. The solution in this was weak and it failed to work efficiently. Meanwhile two sprinklers operated and extinguished the fire. The chemical extinguisher had not been recharged for somewhat over two years and it is thought that had it been working properly the employee could have completely extinguished the fire.

Chemical extinguishers of the carbonic acid gas type should be thoroughly cleaned and recharged at least once every year.

H-10991. This fire occurred in a 825 K.W. air-cooled transformer stepping power from 13,200 to 430 volts to supply the rotaries. A breakdown in the high tension windings caused the insulation to become ignited. The operator discovered the blaze by the smoke which issued from the transformer and immediately shut down the air blast, opened the controlling switches and lifted the cover off the transformer. A considerable blaze was found inside but was necessarily confined to a small space in the transformers. Five extinguishers of the carbon tetrachloride type were emptied into the transformer but they had no apparent effect on the fire, and the fumes so choked the operators that they were forced to get fresh air. The fire was finally smothered by completely filling the interior of the transformer with sand.

Fire Doors.

H-10544. All the fire doors closed automatically and no fire passed through them. The fire door on the car barn side of the wall between the barn and sub-station had the tinning on the outside broken open, exposing the wood, one layer of which burned off. The rest of the door

was intact. The fire door nearest the fire at the boiler room opening was practically destroyed, but the inner door at this point was uninjured.

H-10634. Fire doors on the inside of building did a great deal to keep the fire from the front section. Only those on the third and fourth floors were called into action but others on the floors below closed themselves when the heat came through the windows. Not a single failure was found in the automatic operation of the fire doors. In a number of places the links were still in place but had fused. The fire doors on the floors where the fire occurred were all more or less damaged and only two were still in place, owing to the fact that the others had been knocked down by the firemen in order to fight the fire from this point of vantage. One of those which were still in place looked as if it had been ruptured by an internal explosion, the tin on the inside being blown out and the interior woodwork practically consumed, although it was still in its place. The other was in better shape, the tinwork being intact, but the interior woodwork was consumed. These doors as well as those that were removed stopped the fire from communicating to the front section of the building.

S-16692. Coal oil or kerosene was used in cleaning zinc in a metal tag stamping machine. An employee was sent out to the shed to get kerosene and by mistake brought back a five-gallon can of gasoline. In order to make sure that he had kerosene, he poured some of the liquid on the floor and applied a match to it! The prompt operation of two sprinklers together with the melting of the link on the fire door, which closed promptly, confined the blaze to this room. The loss was slight.

H-10800. This fire started from an unknown cause in a large four-story brick building of wood joist construction. Fire was discovered burning near the boiler room which was separated from a wood-lined elevator shaft by a wooden partition. Watchman attempted to extinguish it with water from a chemical extinguisher but after several minutes found he was unable to do so and then pulled an A. D. T. fire alarm box. At that time flames were issuing from roof house over elevator shaft and from east windows, fire evidently having spread up through shaft while the watchman was fighting it in the basement.

At a previous inspection the fire doors in the parapetted fire wall between the two sections were found in a poor condition, some of them being off the track and others propped open. Although they were placed in good condition at that time, it is apparent that before the fire they had again been allowed to get out of order for when the fire department responded they found flames issuing from both sides of this wall, and the two sections of the building were practically the same as if no fire wall were there.

The basement of one section was equipped with automatic sprinklers and apparently these kept the fire out until the floor fell in, due to the collapse of the floors above. Even after this, fire was held in check in this section. All of the walls excepting the north wall fell during the

course of the fire. A large portion of this north wall remained standing and was the cause a few **weeks later of the death of seven workmen** who were engaged in clearing away the ruins.

This fire emphasizes very strongly two points: (1) that fire doors and similar apparatus should always be maintained in the best of condition; and (2) that the watchman should be instructed to promptly send in an alarm even if he believes fire to be of no consequence.

The loss of approximately $150,000 indicates what may result from failure to observe the above rules.

Watchman.

S-17883. Fire occurred on the third floor in passageway to the main building, originating in a truck of sweepings. One sprinkler head operated and extinguished the blaze before the arrival of the insurance patrol. The watchman heard water flowing and immediately telephoned to the chief engineer, informing him that a steam pipe was leaking. When he was told that there was no steam in the building he went back and, noticing smoke, called up the A. D. T. office and asked for fire-call telephone number. He then sent in an alarm instead of using the A. D. T. alarm box in the building. While waiting for the fire department he went back to the third floor and moved the truck of sweepings to the center of the floor instead of shutting off the water, which flowed for about twenty minutes and caused considerable damage to the stock on lower floors.

This is a good illustration of the results obtained from an incapable or improperly instructed watchman.

Thermostats.

S-17520. Thermostats apparently were of the same melting point as the automatic sprinklers. The signal was received from them at fire alarm headquarters but was interrupted probably by the water from a sprinkler head, so that the alarm as received was mixed. This confusion of the signal caused a slight delay.

Miscellaneous.

H-10805. This property consisted of several buildings and was protected by a large water tank and a private system of yard hydrants supplied through a 1000-gallon fire pump. On the day previous there had been a serious fire in one of the buildings, which had been extinguished by the employees with hose streams. On the morning of the second fire the watchman was just leaving the plant office when he saw flames and smoke issuing from the south side of one of the buildings. He immediately sounded the alarm whistle but could not get the fire pump in operation promptly. It is supposed that the first fire had impaired the protection to such an extent that the system was of little value. Apparently little

effort was made to fight this fire for it should have been a comparatively easy matter to avoid the loss of some of the buildings which burned, since there was practically no wind.

The necessity of immediately placing all fire apparatus in good condition after use is apparent.

S-17884. This fire occurred in a knitting mill and had spread to a card when it was fought by employees with chemical extinguishers and a stream from a standpipe in the card room. Fire was kept down so that heat did not open sprinklers, but there was considerable water damage due to the fact that the men lost control of the nozzle for a time, with the result that the adjoining cards were also wet down.

Fires in Which There Was Loss of Life.

These fires are intended to point out conditions under which loss of life occurs, that they may be known and guarded against.

Holocausts which are adequately reported in the daily press or are the subject of special investigation may not be given herein; nor is any complete record of loss of life in fires at present obtainable.

H-11007. Ardmore, Oklahoma. September 27, 1915. On this day a terrific gasoline explosion took place at 2.20 p.m. which killed forty people and seriously injured several others and resulted in a large property loss from the force of the explosion and fire which followed. The accident was caused by the leaking of gasoline from a tank car on the tracks of the Santa Fe railroad. The car in question contained casing-head gasoline. This gasoline is manufactured from the gas taken from live oil wells which is run through heavy compressors. This particular car of gasoline had been shipped from the Cushing field about one hundred miles distant from the local refinery. It was to be blended with a lower grade of gasoline or naphtha in order to make a marketable product. The car reached Ardmore either during the night of September 26th or early on the following morning. September 27th was clear, sultry and hot, with very little motion of the air. It was stated that by nine o'clock in the morning, gas was escaping from vents in the top of car and by noon persons could detect the odor of gas at a distance of 150 feet from the car, and undoubtedly this gas had permeated the atmosphere for a distance of two or three hundred feet.

The evidence shows that a street commissioner was informed of the danger, that he notified the railroad agent, and the latter notified the refining company to whom the car was billed. The refinery manager sent a man to the car and he climbed on top and raised the vent cap. It seems that simultaneously with this action a terrific explosion occurred. Com-

missioner Henshaw, a member of the corporation commission, states that the car originally contained 250 barrels of gasoline and 125 barrels were still in the car after the explosion, which would indicate that the car did not explode, as was the first impression. It will probably never be determined from what point the gas exploded. The striking of a match anywhere within 300 to 500 feet from the car might have caused the explosion.

The property loss resulting from the explosion and fire has not been definitely determined at this date but will probably amount to two or three hundred thousand dollars.

H-10578. The watchman was an elderly man who apparently did good work in the discovery and notification of fire. The excitement was too much for him, however, and he succumbed to heart failure immediately after the fire was extinguished.

H-10834. Tailor Shop. This small frame building was occupied by a tailor shop, barber shop, pool room, etc. Tailor is supposed to have been cleaning clothes in gasoline while an open gas light was used for illumination. An explosion occurred and he was burned to death before help arrived, therefore the exact details were not obtainable. Building was totally destroyed and two others were damaged.

H-11073. Tannery. This fire started from an unknown cause in a brick building with joist roof and floors. It spread with such great rapidity that by the time fire department arrived it was too late to save the property. When the roof of the building fell in, the south wall also fell outward, crushing six firemen, two of whom were instantly killed. The remaining four were more or less seriously injured but have since recovered.

H-10810. A serious explosion, which fortunately did not result in fire, took place in a japan baking oven in the premises of a metal-working establishment. This oven which was badly demolished by the force of the explosion was approximately two by four by four feet, built of sixteen gauge sheet iron on 1½-inch angle iron framing lined with ¼-inch asbestos sheets except at the bottom. Asbestos was held flat on oven walls by wrought iron straps riveted throughout. Vertical sliding iron door in front of the oven was of similar construction. The bottom of the oven was constructed of sheet iron perforated with twelve two-inch holes, all resting on iron legs two feet above metal shield on wood floor below it. The oven was heated by two 1¼-inch perforated gas pipe burners inside of it which rested on the metal bottom. The firing chamber was not properly cut off from the baking chamber but was baffled above the burner with a removable sheet iron plate about twenty-four gauge metal. The baking chamber was vented by a four-inch metal stove pipe upwards and away from the oven for a distance of eight feet, where this joined the smoke pipe of the forge hood and passed to the brick chimney. Japanning was done by a hand brush from 2½ gallon pails of japan which was thinned

with turpentine. This process was not separated from the balance of the shop and the room was lighted by exposed gas jets. There was also a gas-heated case-hardening furnace two feet behind japan oven and a hooded coke forge about three feet in front which was in operation at the time of the explosion. The oven had not been in use for at least a week and although containing japanned stock, was not lighted. The explosion was undoubtedly due to an accumulation of gas inside of the oven which was caused by the accidental opening of gas cock. This gas was ignited by the back-fire from smoke pipe connected to coke forge. The violence of the explosion is evidenced by the complete demolition of the oven, the bent and distorted condition of forge hood in front of it, the upturned screw press and bent spindle of drill press beyond caused by the door of the oven in its flight of about fifteen feet across the room, also the blowing out of all glass windows and part of the sash in this particular part of the loft. The building was not injured otherwise.

One person, a boy eighteen years old, lost his life at the time. He was struck by the flying oven door while operating the forge and standing directly in front of the oven.

Conclusion: This explosion, although it did not result in fire, shows the importance of properly constructing and heating japan ovens by steam or electricity or, if necessary, by live fire heat such as gas, to so arrange the firing chamber that it will be hermetically sealed from the baking chamber, thereby avoiding the possibility of flame igniting inflammable vapors or accumulated gases.

S-17329. This fire occurred in a small one-story frame building used for mixing a waterproofing material consisting of rosin, benzol and alcohol. The plant was shut down for the night and a small Italian boy was sent to lock up this building. The boy was seen to enter the building and a few minutes later an explosion occurred which practically demolished the building and sprinkler system. The boy managed to crawl out of the debris but was so badly burned that he died a few hours after. He claimed he was not smoking and the cause of the fire is unknown.

The sprinkler system took no part in extinguishing the fire as it was broken by the explosion and the water was shut off at supply connection immediately. Fire was extinguished by four lines of hose used by the mill brigade.

It is not known how large a quantity of alcohol and benzol was in this building but apparently two metal mixing pots were fairly well filled with this material.

H-10876. Oil Storage Station. Building in which this explosion occurred was a small two-story structure of brick and concrete, with twelve-inch walls and reinforced cinder concrete floors about six inches thick. The first floor was divided into three sections by four-inch tile partitions communicating directly with one another through kalamein doors. An open stairway extended from the pump room of one of these sections to the second floor.

Plant as a whole was occupied by a wholesale gasoline and kerosene oil station. The main storage of oils was in four tanks buried near the center of the yard, each of 18,000 gallons capacity, two being used for kerosene and two for gasoline. On the second floor of the building there were two steel tanks, each five feet in diameter and eight feet high and holding 1,100 gallons. One of these tanks was used for kerosene and the other for gasoline. The oils were pumped into these elevated tanks from the underground tanks by two horizontal duplex plunger pumps, one for kerosene and one for gasoline, located in the first story of building. These pumps were driven by a belt from a single phase A. C. electric motor in the motor compartment on the first floor. The motor was operated by a control switch on the south wall of this room. Two-inch delivery pipes with meters and control valves led from the elevated tanks to a loading platform adjoining this tank building and to the loading platform on the east side of the yard so that drums and tanks could be filled by gravity feed. The pumps were operated whenever it was necessary to fill the elevated tanks, and it is claimed these tanks were drained at night.

Story of Explosion: At the time of the explosion there was a switching locomotive attached to two tank cars standing directly in front of this gravity tank building. The locomotive engineer observed oil flowing from the door of the building and told four small boys who were also watching the flow of the oil, to run to the office and tell the book-keeper. They did so, returning immediately to the tank building. The book-keeper went to the other side of the yard and told the manager that the oil was overflowing. The manager entered the building and a moment later a terrific explosion occurred, practically demolishing the building. The tanks fell and burning gasoline and kerosene flowed over the ground. As far as could be ascertained there was no explosion in the tanks. The door under which the gasoline had been seen flowing was found nearly 200 feet distant. The manhole cover on the top of the gasoline tank was seen, immediately after the explosion, hanging by one stud bolt. The other studs were broken off but the fractures were rusted and darkened as if they had been broken a long time. If such was the case, then the manhole cover was practically only laid on top of the tank and when the tank had been filled by the pump the gasoline flowed over the edges of the manhole, over the floor and down the open stairs.

There are two theories as to the ignition of the gasoline. The first is that it was ignited from the fire-box or sparks from chimney of the locomotive only fifteen feet distant from the building. The other is that the manager who entered the building pulled the motor switch, which furnished the necessary spark to ignite the explosive mixture of gasoline and air in the house. This latter theory seems rather more probable as the main explosion was inside the house and it occurred immediately after the entrance of the manager.

The tank house was practically demolished. The contents of the tank were burned except a few barrels of gasoline which with considerable water were found in the gasoline tank after the fire. The cab

of the locomotive was practically burned off. The contents of the underground gasoline and kerosene tanks were intact. Many windows in the vicinity were shattered by the concussion.

Loss of Life: The manager who was in the building at the time of explosion was killed. The four small boys were caught by the falling walls and killed. An old man who was standing nearby was so seriously injured that he died later.

Conclusions: The storage of volatile inflammable oils in gravity tanks above ground is a dangerous condition and should be avoided if possible. The motor room in this case communicated to the pump room directly by a door opening. Access to such motor rooms should be only by doors opening to the outer air.

S-17907. A one-story frame building was used in part for dehydrating nitrated cotton and also for washing the nitrated cotton before dehydrating. It was customary to take about 150 pounds of nitrated cotton just before closing time at night and place it in this building on frames to dry overnight. In the morning a man would bring it back to the dehydrating room in small lots in metal cans. On the morning of the explosion the regular man for this work was absent and his assistant who had only had two weeks' experience was doing the work with the help of a man from another department. The first batch of forty pounds had been brought in and was being treated. While the assistant went for another supply of this cotton the first two cans were being treated in the usual manner, when there was a terrific explosion which badly wrecked the building and the sprinkler system. The fire was readily extinguished by the private fire brigade using three hose streams. The two men mentioned above were instantly killed.

The cause of the explosion was probably due to one of two things: that a mistake was made and some material other than alcohol was being used, or more likely, that there were impurities in the cotton or alcohol which caused a chemical re-action, resulting in spontaneous combustion and the resulting explosion.

H-10786. The building in which this fire occurred was a large brick structure of three and four stories in height. The roof and floor construction was light joist with poorly protected floor openings. There were also several wooden chutes through the floors together with belt holes. It was occupied as a mustard, spice and drug mill. The raw stock was usually imported. Processes consisted of grinding and sifting the material.

This building was connected with a building at the south by twenty-foot long iron bridges which were cut off by good automatic fire doors. These fire doors were of assistance in preventing the spread of flames in this direction.

Occasionally dry shellac in flake form was pulverized for a special customer. At the time of the fire some 2500 pounds of this material were in the building. The raw stock was received on the fourth floor

and emptied into a wood hopper and fed through a wooden chute to an ordinary belt-driven wood-enclosed disc mill on the third floor. From this mill the powdered shellac was discharged through another chute to a wooden hopper on the second floor where it was fed to a sieve, sifted and packed in bags. The fine dust from the mill was discharged into a bag which hung at the end of a metal spout. The mill had been running one day on this shellac and about thirty minutes on the following morning, when the fire occurred. Fire started with a mild explosion in the discharge spout of the mill, followed by a severe flash fire which extended to the third and second floors, badly burning the employee who was tending the mill. The cause of the fire is attributed to a spark brought about by some metallic substance in the stock. There appears to have been a very quick initial spread of the fire on the second and third floors followed by a very dense smoke, as the flames ignited stock of shellac and dried drugs stored in bulk. The poor and unprotected floor openings and thin floors, wood chutes, spouts, etc., greatly aided the spread of fire from floor to floor, both up and down. No private apparatus was available except water pails which were of no use in this instance. Four public alarms brought out a large amount of fire apparatus and resulted in keeping the fire confined to the original building and a small adjoining boiler room.

One employee was killed by jumping from the third floor window. He apparently became frightened when the smoke confined him, and he jumped without waiting for assistance.

Fire Causes.

The fires here given are selected to illustrate defects, either of construction or superintendence, in the classes of property indicated.

Gasoline or Other Volatiles.

S-17652. Fire occurred in an open pail containing two gallons of gasoline in the dyeing room while the operator was mixing some dye stuff. The cause was undoubtedly due to static electricity. As soon as the material started to blaze, the man seized the pail and ran out of the building. In attempting to throw the flaming can away he was severely burned and dropped it close to a frame shed, which immediately ignited. This shed was totally destroyed and the fire extended to the doorway of the main building which had been left open by the man on leaving. At this point the heat caused three automatic sprinklers to operate which prevented the fire from entering the main plant. The loss was approximately $10,000.

H-10659. Fire followed an explosion generally thought to have been caused by gasoline vapors passing down into boiler room from the floor above where a man had been repairing a carbureter and probably spilled some gasoline.

S-17501. Shoe Factory. This fire started on a treeing bench where the irons are heated by a gas flame. Before they are used on the shoes a mixture of vaseline and benzine is rubbed over them. This material is used from an open dish. An employee started to light the illuminating gas jet using a piece of paper instead of a match. This paper was ignited from flame used to heat treeing irons. The lighted paper was accidentally dropped into the open dish of vaseline and benzine, which immediately burst into flame.

This is merely another example of the innumerable fires caused by the use of open lights in the vicinity of volatile liquids.

S-17446. Shoe Factory. Girls were working at a finishing bench cleaning cloth top shoes with naphtha. This liquid was used from a safety can. Twenty-one inches directly over this bench was an inverted Welsbach light which was burning. Ten pairs of shoes which had just been cleaned were under this light. Suddenly there was a flash and these shoes began to burn. The fire was confined entirely to the shoes, and the naphtha in the safety can did not ignite. Fire was extinguished with a hand chemical extinguisher.

This fire illustrates both the value of safety cans and of having hand chemical extinguishers placed at frequent intervals about a factory.

S-17851. Shoe Factory. This fire was caused by lighting a gas jet near an open dish of naphtha. At one of the benches in the finishing room there was a small open dish of naphtha used for removing spots on fancy shoes, also a gas jet with stand on it located about eighteen inches above the table. An employee lighted the gas to heat some coffee for lunch. The naphtha fumes ignited and in turn set fire to the naphtha in the dish. The employee attempted to throw the dish out of the window but dropped it, thus setting cotton window shades on fire. Automatic sprinklers operated and extinguished the flames. A loss of $655.00 was caused by water soaking numerous racks of finished shoes in this vicinity, as there was considerable delay in closing the valve after the fire was out.

S-17843. Shoe Factory. An employee had been cleaning cloth tops of shoes with gasoline. While the shoes were still wet, he started to light gas jet with an ordinary parlor match. The head of match flew off and ignited the first shoe, from which place the fire spread to other shoes nearby. Fire was extinguished by employee who threw his coat on the blaze and smothered it.

This fire is one of many which have been recently reported due to the use of gasoline for cleaning cloth-top shoes. If it is absolutely

necessary to use this dangerous material the usual precautions should be taken, and under no circumstances should an open flame of any kind be allowed in the vicinity.

S-16739. This fire in a factory manufacturing agricultural implements was caused by naphtha dripping through the floor onto an electric motor on the floor below. Eighty-two automatic sprinklers opened and held the fire in check.

S-18262. The night man was filling an automobile tank with gasoline from a self-measuring gasoline pump when the gasoline flowed over and was ignited, due to the smoking of some of the people in the automobile. Fire traveled to the pump and walls nearby and was extinguished by a two and one-half gallon chemical extinguisher.

S-17858. This fire was caused by a ten-gallon can of germicide which was used for disinfectant purposes. Apparently the contents of this can had been spilled on refuse which, in turn, came in contact with hot steam pipes and was ignited. A test of this germicide showed it to be of very inflammable character.

S-17995. Fire occurred in a metal enclosed room used for spraying on a lacquer, "aus-per-ite", which apparently contained benzine. The spraying was carried on under metal hoods which were equipped with blower for exhausting fumes through metal pipes to the outside air. Plant was shut down and three or four employees were busy cleaning up the machinery. One of these men was scraping off an accumulation of lacquer from the inside of above mentioned hoods when he struck a spark which caused the lacquer to ignite with a slight explosion. This employee was very seriously burned. Four sprinklers in the lacquer room and four outside of room opened promptly and practically extinguished the fire. The wired glass windows assisted in confining the fire to the building.

H-11027. This fire took place in an enameling plant. It was apparently caused by sparks from a passing locomotive coming through the open ventilator and dropping into a large dip tank. This immediately took fire and communicated to another dip tank. The enameling fluid, which was stored in barrels, also caught fire, each one exploding and scattering the burning fluid over a large area. The fire department did not respond until a second alarm was sent in because of some failure of the signaling system, and when they arrived it was too late to save this building but they did protect surrounding property. Loss was about $30,000.

Electrical.

S-17614. A six H. P. 440-volt motor was started by closing a knife switch and was protected by three standard fuses. On account of the comparatively heavy starting current twenty ampere fuses were used. When the switch was thrown and the motor did not start, only one of these fuses blew, leaving the motor stopped with current on two phases.

This resulted in heating up the insulation on motor until it commenced to burn, when the fire quickly communicated to the box in which the motor was installed which was more or less oil-soaked.

S-17914. Individual motor in starting box was located at this machine, which was operated by a girl. It is evident that when she shut down the power at noontime the starting box must have been thrown over to one of the notches instead of being left in the off position. Shortly after noon a boy from the street ran into the office and told the superintendent that one of the machines was on fire.

Spontaneous Combustion.

S-18019. This was the third fire within two months and apparently all originated from the same cause, namely, spontaneous combustion of oily rags in bales of waste paper bought from outsiders. A very complete investigation seemed to indicate that the fire always originated in bales of waste paper obtained from one particular firm.

S-18211. This fire was undoubtedly due to spontaneous combustion in barrels of zinc dust. The watchman was making his rounds and discovered a barrel of this material ablaze. It is probable that there was some moisture present in this zinc dust which caused it to ignite spontaneously.

S-17504. This property was occupied by a firm which made light cotton goods. The fire originated under a cutting table. Linseed oil had been spread over the table during the afternoon for the purpose of smoothing the surface on which goods were laid out for cutting. A basket of flannel cuttings had been left under the table and it is presumed that they became saturated with linseed oil, causing spontaneous combustion.

S-18128. Fire occurred in a wooden bin used for the storage of clean rags in a printing establishment. Fire was probably caused by spontaneous ignition. A peculiar feature was the rupturing of a six-inch tile wall which enclosed the room in which this bin was located. An area of eight feet high by eight feet wide in the east wall of the room was forced out into the adjoining room by the expansion of hot air and gases, for there appears to have been no explosion.

Phosphorous.

S-17929. Foundry. The insurance patrol were passing the premises on returning from a nearby fire when they noticed the reflection of flames in a window on the fifth floor. They entered the building and discovered a can of phosphorous was burning on a shelf in the foundry room. Three sprinkler heads operated and held fire in check, while the burning phosphorus was extinguished with moulding sand.

S-18008. Brass Foundry. Phosphorous was purchased in sealed cans containing about eleven pounds each. The phosphorous was covered with water. The most probable cause of the fire is that there was a defective can which had allowed the water to drain off the phosphorous and at the same time permitted air to reach it. The prompt discovery by the night watchman prevented a serious loss.

Lightning.

S-18039. During an exceptionally severe thunder storm, a generator, three motors and the wiring in two places was damaged by lightning, and fire resulted in both places where the wiring was injured. The points where trouble occurred were scattered, there being a distance of about 1450 feet between the most widely separated points. The damage was apparently not done by direct strokes but by secondary effects resulting in high voltages between wiring and ground. In engine house B, a generator and motor were damaged and the insulation on a number of the bars was punctured and short circuits resulted. In engine house A the insulation on a temporary slow-burning type cable connecting the two switchboards broke down and a short circuit occurred between conductor and a grounded bolt securing a large porcelain cleat to the ceiling. Molten metal ignited a small amount of combustible material beneath the cable, and the resulting fire damaged several cables in service and a large cable on a reel stored in the basement. On the fourth floor the insulation on a rubber-covered 300,000 cable in conduit on the ceiling broke down and short circuits damaged all the cables in the conduit. The arc was extinguished by the blowing of the protecting fuses. The conduit was burned through and the roving in cans beneath was ignited. Fire spread to cotton on two spinning frames nearby. It was finally extinguished by two small hose streams. In building No. 7, on the fourth floor, a short circuit occurred at end connections of a 150 H. P. 400-volt motor and a number of coils were damaged. From the appearance of the damaged coils it would seem that the arc persisted for several seconds.

Total loss was several thousand dollars.

Construction.

S-17613. This fire occurred on the fifth floor of a brick building with joist floors. The only damage was due to the water which ran down through the entire building, even causing damage to the fruit store on the first floor. Fire itself did not cover a space of over one square yard where it started from spontaneous combustion.

Water-tight floors are of great value in preventing water damage even in comparatively insignificant fires.

S-17866. This fire was caused by a poorly arranged japan baking oven and was practically confined to the contents of the oven by hose streams and five sprinklers which opened outside of the oven and per-

vented the fire from spreading. There were eight two-inch pipe holes in the floor of the japan room. The pipes had been removed but the holes had not been plugged. The water poured down through these holes and damaged some 600 motor generators for automobile starting and lighting systems on the floor below. The damage on this floor was a great deal more than on the one where the fire actually occurred and amounted to nearly $10,000.

There were scuppers in the north wall of the upper floors and these were used to good advantage in sweeping out the water, although the outside clappers stuck so that they had to be opened by hand.

S-18126. A coal heated melting pot on stereotype furnace was placed on an eight-inch concrete slab above the wood floor built up as follows: One-inch wood floor resting on joists, 3-ply asbestos, 2-inch concrete, three layers of expanded steel (for air space), and six inches of concrete. The concrete floor extended about ten feet in front of the melting pot and, from all appearances, there were no cracks in the concrete.

One morning the employees on coming to work noticed smoke coming through the fourth floor. Holes were chopped through this floor and the joists were found charred, and the smoke appeared to be coming from under the cement floor. Further investigation showed that the woodwork under this furnace was badly charred and smoking.

This fire emphasizes the necessity of having a very liberal air space and insulation between woodwork and a furnace of this type. The continued use of such a furnace will produce a dangerous temperature through a surprisingly large amount of insulation.

H-10978. This building was occupied by tenant manufacturers, mostly leather workers. It was largely of frame sheathed construction and practically without cut-offs, although the office section and boiler house were equipped with standard fire doors, which for some reason failed to operate.

Fire started from unknown cause and spread with tremendous rapidity, necessitating five alarms. The district chief estimates that he was on the scene of the fire a minute and a half after the first alarm was received and found flames issuing from three floors of the building, while the heat was very intense and had begun to scorch buildings over a hundred feet away. This building was totally destroyed. A fireproof garage about fifteen feet to the east which was equipped with wired glass windows in metal frames, did not suffer any material damage.

This fire illustrates the serious special hazard presented by a building of this type in closely built residential or manufacturing districts. When a fire can make such rapid progress that it taxes the resources of a large city fire department to its utmost, it can be readily appreciated what the result would be if this building were located in some smaller community.

H-10785. This fire in a general store was caused by a brick falling out of flue and allowing flames to come in contact with the woodwork. Loss amounted to $37,000.

Dust Explosions.

H-10825. Flour Mill. This property consisted of a moderate sized roller flour mill having a daily capacity of about 100 barrels. Building was two and three stories in height and basement and of open joist brick construction. Cyclone dust collectors were installed on the third floor and dust was placed in sacks and removed regularly. Open dishes of carbon disulphide were placed throughout the building for the killing of roaches and bugs. Fire was apparently caused by dust explosion which blew out the light eight-inch wall in the east end of the warehouse section, from which the fire crept through the frame passage to the mill where a dish of carbon disulphide ignited and assisted materially in the spread of the flames. As the fire reached each open dish of this material there was a minor explosion.

The outside standpipe could not be used since the windows were obstructed by iron bars. Building was seriously damaged and the loss was approximately $30,000.

S-17899. Fire was probably caused by foreign metallic substance in rags coming in contact with the metallic teeth of the shaker machine in this wool and shoddy mill. The shaker is a machine which is used to shake up the cloth after it has gone through the carbonizing machine, which removes all the cotton in the rags, leaving the woolen material. The dust is carried from the shaker machine through metal pipes by means of a blower system to the outside of building and deposited in a brick vault in the boiler room, also in a small room on first floor which is enclosed by wire lath and cement plaster partitions. This small room is connected to the brick vault in the boiler room by a 16-inch metal pipe. The fire evidently was carried from the shaker machine through the metal pipe on outside of building to the dust vault in the boiler room, where an explosion occurred. It also extended to dust room on first floor through the sixteen-inch metal pipe. The explosion blew the metal drop door off the vault and bulged the brick wall out, also blew the wooden doors off the boiler room including one of the door jambs. In the dust room on the first floor the expanded metal and cement plaster partitions were bulged out about a foot in the center. Two sprinkler heads opened in this room probably due to heat from the dust explosion although no traces of fire heat could be found.

Miscellaneous.

H-11203. This building was constructed of brick and stone, wood joist, and was two stories in height and basement. An open stairway led to the second floor and roof, causing the fire to spread rapidly. There were no cut-offs nor fire doors in the building.

Early in the morning the janitor turned an electric switch in the rear of the store which caused an explosion of gas which had leaked in from the street main or service pipe through the basement wall into the building. It is said that the smell of gas had been noted for several days but had not been reported or investigated. This explosion blew out the front of the building and set fire to its contents. The fire spread to the third floor of adjoining building on the north, causing a total property loss of over $20,000.

About ten minutes after the first explosion a second one occurred in the two-story building adjoining on the south, which was occupied by a drug store. This explosion seemed to have been between the floor and ceiling of the first story and did not result in any fire but caused considerable damage.

S-17876. The back fire from a small portable gasoline engine ignited a piece of wiping waste nearby, causing the flames to spread over the engine. As there were neither fire pails nor extinguishers at hand the operator quickly knocked off a sprinkler head, and the fire was immediately extinguished.

S-17973. A weaver laid an electric light on the frame of the head motion of a Jacquard loom. The lamp was jarred off and it struck the shuttle box, breaking the bulb and setting fire to the loom. Fire at once communicated to the adjacent loom through the overhead framing. There was a loss of $2,208.

The value of a proper lamp guard for all electric lights is obvious.

S-17881. This fire occurred in a rag warehouse in some old burlap bags which originally contained sodium nitrate. Considerable of this material was still clinging to the bags and it seems very probable that the fire was due to a spark from a switching locomotive being blown in through open window. The burning burlap gave off a dense smoke and burned very fiercely. One sprinkler head operated and extinguished the fire. Tests made of others of these bags afterwards showed that those having sodium nitrate clinging to them could be ignited by a small spark and that they burned with a great violence, giving off dense clouds of dark gray smoke.

Standard Regulations

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